AMERICAN MUSEUM
NOVITATES

PUBLISHED BY THE AMERICAN MUSEUM OF NATURAL HISTORY
CITY OF NEW YORK NOVEMBER 9, 1951 NUMBER 1536

# FURTHER STUDIES ON ALASKAN HALACARIDAE (ACARI)[1]

By Irwin M. Newell[2]

The marine mites recorded from Alaskan waters now number 14 species, all of which have been described in four papers by the writer (Newell, 1949, 1950, 1951a, 1951b). In the present paper, 11 new forms and two new records are added, to bring the total for the region to 27, 19 of which belong to the genus *Copidognathus* alone. This is by no means the entire Alaskan arctic fauna, for the Rhombognathinae have not yet been touched. At least three species of this subfamily are known to occur there, in the genera *Rhombognathus* and *Isobactrus*.

The abundance of species of *Copidognathus* is surprising, for approximately 60 per cent of the forms belong to that genus. Such a preponderance of *Copidognathus* is typical of the tropical fauna known to date (Newell, 1947, pp. 205–206), but generally the genus is not so well represented in the temperate and cold water faunas. In studying the Alaskan Halacaridae the writer has been impressed more than ever by the minute differences separating some of the species of *Copidognathus* and by the inadequacies of existing keys and diagnoses. The demonstration of identity or differences between the species of Alaska and those from other parts of the world proved so difficult that the writer was ultimately forced to adopt the policy of regarding all the species as new. This was done even in certain cases in which the relationship between the species of Alaska and those of other regions was obvious, for example, (1) *C. brachystomus* Viets, 1940 (Adriatic Sea), and *C. brevimaxillaris*, new species; (2) *C. aequalivestitus* Viets,

[1] This study was made possible through aid provided by the Arctic Institute of North America and the Office of Naval Research.

[2] University of Hawaii, Honolulu, Hawaii.

1950 (Falkland Islands), and *C. punctatus* Newell, 1950; (3) *C. poucheti* (Trouessart), 1893 (Iceland), and *C. orientalis* Newell, 1951. It was not possible to point out reliable differences between the members of these three pairs of species, yet it was felt that a direct comparison of specimens would reveal differences in every case. Sometimes differences could be inferred from figures given in the literature, but this was a risky procedure at best, since in most cases they involved structures which generally have not been used to differentiate species. For that reason, the structures were not clearly represented, or they were indicated so sketchily and diagrammatically that little confidence could be placed in the accuracy of the representation.

In studying the Alaskan Halacaridae, the writer has gained a deeper insight into the value of certain morphological characters which have been used but little or not at all in the differentiation of species. This is especially important in *Copidognathus*, a very large genus of approximately 120 known species, 20 of which have been described from the North Pacific and its adjacent arctic or subarctic waters. The fauna of the entire world would doubtless number hundreds of species and subspecies, perhaps nearly a thousand. The necessity for having a sound understanding of the nature and extent of interspecific and intraspecific variations can scarcely be overemphasized. The writer has prepared a table of characters, which are relatively easy to interpret and which show a moderate to high rate of interspecific variation, combined with a relatively high degree of constancy within species. Many others could be given, but this would make the list inconveniently long. If a perfect random distribution of characters among the species is assumed, 12 characters would suffice to differentiate more than 4000 species. Of course, such a random distribution is never encountered. For example, in the key following the list of characters, *Copidognathus arcticus*, new species, and *C. vulcanis* Newell, 1951, have identical formulas and must be differentiated by characters other than those employed in the key. The separation of these two is discussed under the description of *C. arcticus* in this paper.

The construction and use of formula keys was discussed by Edmondson (1949). The key provided here differs from Edmondson's key in that all characters are given for each species. These are listed in the approximate order in which they would be observed on the mounted specimens, rather than in the order of their

reliability. In use, the specimen is compared with the list of characters, and when the alternative in each category that most closely fits the specimen is found, this is written down. When the process has been completed, the resulting formula is compared with the key, in which the formulas are arranged in order vertically, and from left to right. Characters showing two arrangements or an intermediate condition in a particular species are indicated by a double symbol, e.g., 7ab. Where one of the conditions is exceptional, or there is a possibility of an alternative interpretation of the character, the more exceptional one is indicated by italics. For example, in *Copidognathus pseudosetosus* the posterior porose areas of AD are usually distinctly separated, but occasionally are coalesced medially. For this reason, *C. pseudosetosus* is indicated by the symbol 2a*b* in the key, but it is essentially a 2a species. In *C. nubilobius*, the third pair of dorsal setae has been found outside PD in one specimen, inside in another, and in a third case the position could not be ascertained. Because the available material is too scanty to determine which, if either, is the exceptional condition, both are listed as such, 4*ab*.

## PRINCIPAL SPECIFIC CHARACTERS IN THE GENUS *COPIDOGNATHUS*

1a. First pair of dorsal setae anterior to the posterior porose area or areas, or at least anterior to the position these would occupy if present (figs. 16, 68, 84, 87, 97).

1b. First pair of dorsal setae posterior to the posterior porose area or areas, or at least posterior to the middle of these (Newell, 1947, figs. 266, 268; 1949, fig. 2).

2a. AD marked with three distinct porose areas, the posterior two circular or oval in form and completely separated from each other (figs. 29, 57, 68).

2b. Posterior porose areas of AD completely or partially fused medially to form a single, transverse, bar-shaped (figs. 16, 20), rectangular, or ∞-shaped area (fig. 49 of this paper; Newell, 1951b, fig. 1; 1947, fig. 254).

2c. Posterior porose areas elongate, usually crescentic, and distinctly converging anteromedially where they may be completely (figs. 87, 97, 116) or partially (Newell, 1951b, fig. 35) coalesced to form a broad U-shaped or V-shaped elevated area. This in turn may be coalesced with the anterior porose area to form a Y-shaped or goblet-shaped structure (figs. 97, 116, 122).

2d. Posterior porose area single, small, centrally located, and circular or oval in form (Newell, 1949, fig. 2; 1947, fig. 266).

2e. AD lacking any sharply delimited areas of rosette pores or porose panels (figs. 80, 84).

2f. Posterior porose areas of AD very elongate, four or five times as long as broad, parallel, or with anterior ends diverging somewhat.

3a. Second pair of dorsal setae in the membranous area between AD and OC (figs. 29, 49, 83).

3b. Second pair of dorsal setae in the margin of OC (fig. 20).

4a. Third pair of dorsal setae in PD (figs. 20, 83).

4b. Third pair of dorsal setae in membranous area between OC and PD (figs. 29, 49, 57).

5a. AE with well-developed epimeral processes at the insertion of leg I (figs. 86, 94, 115, 121).

5b. Epimeral processes absent or very weakly developed here (figs. 10, 24, 33, 44, 69).

6a. Distance from genital opening of female to anterior margin of GA less than 1.6 times as long as the opening itself (fig. 44).

6b. This interval greater than 1.6 times as long as the genital opening, the genital opening displaced more posteriorly (fig. 93).[1]

7a. Male with 9 to 14 setae on each side of genital opening.

7b. Male with 15 to 20 setae on each side of genital opening.

7c. Male with 21 to 50 setae on each side of genital opening.

8a. Third (first long) pair of maxillary setae placed well anterior to end of rostral sulcus, lying at least 0.20 of the length of the sulcus from the posterior end of the sulcus (figs. 4, 23).

8b. Third pair of maxillary setae at or very near the posterior end of the sulcus (figs. 53, 65, 123), less than 0.20 of the length of the sulcus from the posterior end.

9a. P-3 without a spine on the medial surface.

9b. P-3 with a spine in this position (fig. 4).

10a. III-6 with four, IV-6 with three, dorsal setae (figs. 103, 104).

10b. III-6 and IV-6 with four dorsal setae (figs. 107, 110).

10c. Both III-6 and IV-6 with three dorsal setae.

11a. First two dorsal setae of III-6 widely separated, the distance from the base of the tarsus to the first seta being only one or two times the distance from the first seta to the level of the second (figs. 76, 118).

11b. First two dorsal setae of III-6 closer together, the distance from the base of the tarsus to the level of the first seta being three to eight times the distance from the first seta to the level of the second (figs. 13, 36, 63).

11c. III-6 with only three dorsal setae (as in 4c).

12a. Both III-3 and IV-3 without a ventral seta.

12b. III-3 without, IV-3 with, a ventral seta.

12c. Both III-3 and IV-3 with a ventral seta.

---

[1] The figure of 1.6 was based on the distribution of 41 measurements from as many species. Of these, 11 were from the Adriatic (Viets, 1940, pp. 28–63), 11 from eastern North America (Newell, 1947, pp. 132–172), and 19 from the North Pacific and adjacent arctic waters. In 29 species, this ratio ranged from 0.64 to 1.50, while in the remaining 12 it ranged from 1.71 to 2.89. The shortest interval was found in *Copidognathus curtus* Hall, the longest in *C. punctatus* Newell.

## FORMULA KEY TO THE KNOWN SPECIES OF *COPIDOGNATHUS* FROM THE ARCTIC OCEAN, BERING SEA, AND THE ADJACENT NORTH PACIFIC

Where two alternative conditions or interpretations are possible, the more exceptional one is indicated in italics. Where both are italicized, both conditions are known to exist, but it is not possible to state at present which is the rule and which the exception. All cases of this type stem from insufficient material.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1a | 2a | 3a | 4*ab* | 5b | 6a | 7c | 8b*a* | 9a | 10a | 11b | 12c | *nubilobius*, new species |
| 1a | 2a | 3a | 4b | 5b | 6a | 7c | 8b | 9a | 10b | 11b | 12c | *gigas*, new species |
| 1a | 2a | 3a | 4b | 5b | 6a | 7c*b* | 8b | 9a | 10c | 11c | 12b | *aurorae* Newell, 1951 |
| 1a | 2a*b* | 3b | 4a | 5b | 6a | 7b | 8a | 9b | 10a | 11b | 12b | *pseudosetosus* Newell, 1949 |
| 1a | 2a*b* | 3b*a* | 4*ab* | 5b | 6a | 7c | 8a | 9b | 10a | 11b | 12a | *styracifer*, new species |
| 1a | 2b*a* | 3a | 4a | 5b | 6a | 7c | 8a | 9a | 10a | 11b | 12b | *thomasi* Newell, 1950 |
| 1a | 2b | 3a | 4b | 5b | 6a | 7c | 8b*a* | 9a | 10c | 11c | 12b | *unalaskensis*, new species |
| 1a | 2b | 3a | 4b | 5b | 6a | 7c | 8b | 9a | 10c | 11c | 12b | *curtus* Hall, 1912 |
| 1a | 2b | 3b | 4a | 5b | 6a | 7c | 8a | 9b | 10a | 11b | 12a | *imitator*, new species |
| 1a | 2c | 3a | 4a | 5a | 6a | 7a | 8a | 9a | 10a | 11a | 12a | *brevimaxillaris*, new species |
| 1a | 2c | 3a | 4a | 5a | 6a | 7a*b* | 8b | 9a | 10a | 11b | 12a | *orientalis* Newell, 1951 |
| 1a | 2c | 3a | 4a | 5a | 6b | 7a | 8a | 9a | 10a | 11a | 12a | *arcticus*, new species |
| 1a | 2c | 3a | 4a | 5a | 6b | 7a | 8a | 9a | 10a | 11a | 12a | *vulcanis* Newell, 1951 |
| 1a | 2c | 3a | 4a | 5a | 6b | 7a | 8a | 9a | 10a | 11b | 12a | *propinquus* Newell, 1951 |
| 1a | 2c | 3a | 4a | 5a | 6b | 7a | 8a | 9a | 10b | 11a | 12a | *similis*, new species |
| 1a | 2c | 3a | 4a | 5a | 6b | 7b | 8a | 9a | 10a | 11a | 12a | *dianae* Newell, 1951 |
| 1a | 2e | 3a | 4a | 5a | 6a | 7a*b* | 8a | 9a | 10a | 11a | 12a | *diaphaneus*, new species |
| 1a | 2e | 3a | 4a | 5a | 6b | 7a | 8a | 9a | 10a | 11b | 12a | *punctatus* Newell, 1950 |
| 1a | 2e*c* | 3a | 4a | 5a | 6b | 7a | 8a | 9a | 10a | 11a | 12a | *parapunctatus* Newell, 1950 |
| 1b | 2d | 3b | 4a | 5b | 6b | 7a | 8b | 9a | 10a*b* | 11a | 12b | *kagamili* Newell, 1950 |

One of the most interesting discoveries has been a species of *Actacarus* collected at Dutch Harbor. Of greater importance than the adding of a new species of the genus is the fact that it makes possible the clarification of several important errors in our present concept of the genus. *Actacarus illustrans*, new species, is abundant in the intertidal zone at Dutch Harbor, where it apparently occupies a habitat similar to that of *A. pygmaeus* in the North Sea.

The standard abbreviations used in previous studies on the Halacaridae are used here for the following terms:

AD, anterodorsal plate
AE, anterior epimeral plate
GA, genito-anal plate
OC, ocular plate
P-3, palpal segment three
PD, posterodorsal plate
PE, posterior epimeral plate
I-6, segment six of leg I (tarsus I)
III-3, segment three of leg III (femur III)

The figures were drawn by the author with the aid of a camera lucida. Scales are available for most figures, each subdivision of the scale representing 10 $\mu$, so that a scale with three divisions represents 30 $\mu$, etc. In the scales that are 10 divisions long, a slightly longer mark has been made at the 50-$\mu$ point.

The holotypes are in the collection of the American Museum of Natural History.

## **Thalassacarus commatops** Newell, 1949

NEW RECORD: Attu Island, Alaska, 1.5 miles northeast of Alexai Point. Intertidal, on calcareous algae. June 24, 1948. I. M. Newell.

REMARKS: There are no significant morphological differences between the single female from this locality and specimens from Oregon and California. The size (440 by 330 $\mu$) is somewhat greater, and the texture of the cuticle shows a slight difference, but one that can be appreciated only by direct comparison. As this was the only specimen taken in the Alaska collections, the species is evidently rare in the Aleutians.

### **Thalassarachna schefferi** Newell, 1951

NEW RECORDS: Kodiak Island, Alaska; Nyman Peninsula Intertidal, on *Mytilus* and algae. October 11, 1947. Gary and Helen Daetz.

Adak Island, Alaska; Zeto Point, Rocky Point, and Cape Adagdak. All intertidal. July, 1948. I. M. Newell.

Attu Island, Alaska; Alexai Point and Murder Point. Intertidal. June, 1948. I. M. Newell.

Attu Island, Alaska; Theodore Point. Dredged from rocky bottom, in shallow water. August 20, 1948. I. M. Newell.

### **Thalassarachna agauiformis** Newell, 1951

ERRATUM: In the original description (Newell, 1951a, p. 17), figure 36 was ascribed to *T. agauiformis*. Actually figure 36 is a drawing of the cheliceral tarsus of the male of *Agaue longiseta* Newell, 1951.

### **Copidognathus pseudosetosus** Newell, 1949

NEW RECORDS: Kodiak Island, Alaska; Kalsin Bay. Intertidal, on red algae. September 21, 1947. Gary and Helen Daetz.

Unalaska Island, Alaska; Dutch Harbor. Rocks covered with *Balanus* and algae. August 10, 1948. I. M. Newell.

Adak Island, Alaska; Clam Lagoon, Zeto Point, Cape Adagdak, and Rocky Point. All intertidal, on algae. July, 1948. I. M. Newell.

Attu Island, Alaska; Alexai Point and Murder Point. Intertidal. June, 1948. I. M. Newell.

Attu Island, Alaska; Theodore Point. Dredged from rocky bottom in shallow water.

Umnak Island, Alaska. Dredged from depth of 30 feet. August, 1948. I. M. Newell.

REMARKS: Three out of three males from Kodiak and six out of six from Adak showed no duplication or triplication of the basal pair of maxillary setae. Furthermore, both the third and fourth pairs of setae of the genital sclerites were spiniform in all nine specimens. Males from Attu, St. Paul, and Oregon have the usual four to six setae on the base of the capitulum, and the third and fourth pairs of setae of the genital sclerites are slender and flexible. However, males from Yaquina Head, Oregon, showed some variation in the latter character.

## **Copidognathus styracifer,** new species

Figures 1–13

FEMALE: Body 356–414 $\mu$ long. The one specimen in favorable position for measurement was 356 by 220 $\mu$, length/width = 1.62. AD (fig. 1) only moderately produced anteriorly; porose areas marked with deeply impressed porose panels approaching rosette pores in structure. Remainder of plate minutely reticulate, as are also OC and the portions of PD outside of the costae and lateral carinae. Second pair of dorsal setae typically in the margin of OC, but lying in the membranous area just outside OC on the right side of the specimen drawn. Corneae absent. Third pair of dorsal setae in the membranous area just outside PD (one specimen). Costae and lateral carinae of PD with depressed porose panels which approach rosette pores in form. Remainder of plate distinctly paneled, the panels subdivided so as to give the plate a reticulate appearance. Panels polygonal in form, not circular as in *C. pseudosetosus* Newell, 1949. AE with four areas of porose panels, these occupying the same positions as the rosette pores in *C. pseudosetosus;* remainder of surface reticulate in appearance. Second pair of setae nearer to the margin of AE than to the epimeral pore. Epimeral processes absent or rudimentary (fig. 10, male). PE and GA also reticulate, and with patches of porose panels in essentially the same positions as the rosette pores of *C. pseudosetosus.* GA appearing somewhat cinctured anterior to the level of the genital opening. Membranous area more extensive than in *C. pseudosetosus,* cuticle of plates thinner and less pigmented.

Rostrum reaching only to end of P-2 (fig. 4). Rostral sulcus 0.59 as long as rostrum, first pair of long maxillary setae 0.31 of the length of the sulcus from the posterior end of the sulcus, in the one specimen measured. In a second specimen (male) these values were 0.58 and 0.22, respectively. P-3 with a median spine (not a seta!) as in *C. pseudosetosus,* although in one specimen this was difficult to see because of its orientation. Base of capitulum with porose panels.

Segments of legs distinctly reticulate, femora I and II also delicately paneled. Femora flattened ventrally, ventrolateral and ventromedial surfaces drawn out into low, keel-like ridges.

III-3 and IV-3 with no ventral seta. Ventromedial seta of III-5 pectinate. Tarsi with claw fossa, but with no lateral mem-

CHAETOTAXY OF LEGS

| | I | | | | II | | | | III | | | | IV | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d. | v. | l. | m. | d. | v. | l. | m. | d. | v. | l. | m. | d. | v. | l. | m. |
| 1 | — | — | — | 1 | — | — | — | 1 | — | 1 | — | — | — | — | — | — |
| 2 | 1 | 1 | — | — | 1 | 1 | — | — | 1 | 1 | — | — | 1 | 1 | — | — |
| 3 | 3 | 1 | 1 | — | 3 | 1 | 1 | — | 2 | — | — | — | 2 | — | — | — |
| 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | — | — | 2 | 1 | — | — |
| 5 | 3 | 1 | 1 | 2 | 3 | 1 | 1 | 2 | 2 | 2 | 1 | — | 2 | 2 | 1 | — |
| 6 | 3 | 3 | — | — | 3 | — | — | — | 4 | — | — | — | 3 | — | — | — |

branes. Median claw bidentate and very small, all lateral claws pectinate and with apparent accessory tooth. Parambulacral setae and bacillum typical for genus.

MALE: Resembling female in most respects except characters of GA. The only male available for measurement was 421 $\mu$ long by 246 $\mu$ wide, length/width = 1.71. Second and third pairs of dorsal setae lying in OC and PD, respectively. GA (fig. 5) with 48 setae on each side of genital opening. Genital sclerites as shown in figure 7. Maxillary setae on base of capitulum not duplicated as in typical *C. pseudosetosus*.

REMARKS: This is the second of that group of species characterized by the median spine of P-3. The third, *Copidognathus imitator*, new species, is found in subtidal collections from the Bering Sea and Aleutians, while *C. pseudosetosus* Newell, 1949, is found from St. Paul and Attu Islands to Crescent City, California, from intertidal and shallow subtidal stations. All three species appear to be quite variable in form but can be differentiated on the basis of certain constant features. *C. pseudosetosus*, with its several variants and local populations, is distinguishable by the two patches of rosette pores on the anterior half of GA. *C. styracifer* has porose panels in this position, but the extreme neotrichy of GA of the male leaves no doubt that the differences between these two forms are of specific value. Differences between *C. imitator*, new species, and *C. pseudosetosus* are not so clear cut. However, *C. imitator* never has a frontal spine on AD and also has no patches of rosette pores or porose panels on the anterior half of GA. Only one exception to the latter has been found, a single female from Kagamil Pass which had one rosette pore on one side and two on the other. Also, *C. imitator* is not so heavily sculptured as *C. pseudosetosus*, and the plates are not so extensive.

The term "epimeral processes" was used in one previous pub-

lication (Newell, 1951b), but without explanation. The writer has studied these structures in a number of species of *Copidognathus* and believes that they have systematic value. Their nature can be understood best by an examination of figure 10, in which the processes are seen to be small protuberances on AE, at the base of legs I and II. In *C. brevimaxillaris*, new species, these are much larger, the second epimeral process filling much of the space behind the insertion of leg I. At the same time, the "coxal" portion of leg I is developed more fully in a lateral direction, being angular rather than round as in *C. styracifer*. While the adaptive significance of these structures is by no means certain, they would appear to offer some degree of protection to the base of the leg. A markedly different origin of the epimeral processes is found in *C. punctatissimus* (Gimbel), 1919. Here the first process arises from a point slightly more anterior and medial; in fact, it appears to spring from the posterior border of the camerostome rather than the coxal portion of the plate (fig. 124). The internal epidesmid (the curved structure indicated by the dotted or dashed lines in figs. 10, 121, and 124, just anterior or medial to the first pair of setae of AE) is the landmark which reveals this alternative origin. In *C. punctatissimus*, the base of the epimeral process lies largely anterior and medial to the epidesmid, while in the other species its base is posterior and lateral to that structure. This interpretation is supported by an examination of the second epimeral process of *C. punctatissimus* which is seen to arise from the posterior aspect of coxal area I of AE, rather than coxal area II as in the other species (fig. 124).

DISTRIBUTION: Attu Island, Alaska, 1.5 miles northeast of Alexai Point, male holotype. In coarse sand and gravel. June 24, 1948. I. M. Newell.

Adak Island, Alaska, 1.5 miles north of Zeto Point. On red algae and kelp. July 5, 1948. I. M. Newell.

Unalaska Island, Alaska, Dutch Harbor. Sand and gravel under large stones. August 9, 1948. I. M. Newell.

### **Copidognathus imitator,** new species

Figures 14–26

MALE: Body 337–389 $\mu$ long, 220–259 $\mu$ wide, length/width = 1.50–1.56, averages of four specimens 366 by 240 $\mu$, length/width = 1.53. Very closely related to *C. pseudosetosus* Newell, 1949,

with which it is compared here. AD (fig. 16) without the projection so characteristic of most individuals of *C. pseudosetosus*. Posterior porose areas completely coalesced in all specimens seen by the writer. Canaliculi indistinct. Second pair of dorsal setae in OC (fig. 20), third pair in PD. OC clearly paneled; an area of rosette pores just medial to the area normally occupied by the corneae which are usually absent. PD with four rows of rosette pores, the intervening areas distinctly paneled, the panels subdivided (fig. 20). Canaliculi of rosette pores feebly developed. Membranous areas not so restricted as in *C. pseudosetosus*, striae few, not distinct. Paneling of ventral plates (fig. 24) indistinct except posterolaterally on GA, most of surface of plates finely reticulate. AE without epimeral processes; with porose panels laterally between I and II, and four areas of deeply depressed porose panels, somewhat approaching rosette pores in appearance (fig. 21). Each of these panels has only a few coarse canaliculi. The corresponding areas in *C. pseudosetosus* contain fairly typical rosette pores, with a circular ostium which is lacking in the panels of *C. imitator*. PE without the fovea-like depressions found in *C. pseudosetosus;* with rosette pores developed lateral, anterior, and posterior to III, but not with ventral areas of specialized pores found in *C. pseudosetosus*. GA devoid of either rosette pores or porose panels, in marked contrast to *C. pseudosetosus* in which there are four such areas. Posterolateral portions of GA with prominent panels, but these only rarely contain a few scattered canaliculi, and with only a few exceptions they are not porose panels. Most of remaining portions of ventral plates very feebly paneled, the panels subdivided. Genital opening with 22 to 27 setae on each side (fig. 22). Setae of genital sclerites spiniform, inflexible. Chitinous shelf behind genital opening rudimentary or absent. Penis about as in *C. pseudosetosus*.

Rostral sulcus (fig. 23) 0.73 to 0.74 times as long as rostrum, first pair of long maxillary setae 0.40 to 0.42 of the length of the sulcus from the posterior end of the sulcus (three males). Base of capitulum distinctly paneled, the panels subdivided. A single pair of setae on the base of the capitulum (in *C. pseudosetosus* there are as many as three pairs). Palpi as shown in figure 15; spine of P-3 very small. Legs essentially as described for female.

FEMALE: Resembling the male in most respects except the structure of GA. Body 350–389 $\mu$ long, 246–266 $\mu$ wide, length/

width = 1.42–1.46 (two specimens). GA as shown in figure 26. Panels on either side of genital opening not simple as in male, but many are porose in structure, like those of AE (fig. 21). Ovipositor very short, extending scarcely beyond the anterior border of the genital opening. Number of setae on legs as given in table for *C. arcticus*, new species. Femora I and II greatly swollen, 1.45 and 1.70 times as long as high, ventral keel absent. Segments 3 to 5 of all legs reticulate in appearance, but panels difficult to delimit even on I-3; rosette pores or porose panels absent. Here the pattern is obviously one of subdivided panels, but the walls of the subdivisions are nearly as thick as the walls of the panels themselves. Remainder of segments with a few scattered pores. IV-3 usually, but not always, without a ventral seta, unlike *C. pseudosetosus*. Tarsi I and II with claw fossa, but without lamellae; tarsi III and IV with fossa virtually absent. Tarsus III with four dorsal setae, the proximal two setae lying at the same level, one sometimes hidden behind the other when seen in lateral view. Lateral claws distinctly pectinate, the pecten confined to the medial surface of the claw, not curving around the convex border of the claw (i.e., not J-shaped). For this reason, there is no apparent accessory tooth when the claw is seen in lateral view, nor is there a real accessory tooth. Median claw unidentate, extremely minute, visible with clarity only under oil immersion.

REMARKS: This species is very closely related to *C. pseudosetosus* Newell, 1949, and can be considered the Bering Sea and Arctic Ocean counterpart of that species in the subtidal zone. The possibility that it is only an ecophenotypic form of *C. pseudosetosus* is so remote as to merit only passing consideration, for the differences between them are too great, and no overlapping has been observed. The fact that a second intertidal species of the group is now known, *C. styracifer*, new species, shows that speciation in this unique group has been active. Other members of the group will probably come to light in the future.

DISTRIBUTION: Arctic Ocean, 18 miles northwest of Wainwright, Alaska (latitude 70° 53′ N., longitude 160° 05′ W.), male holotype. Sand and gravel at depth of 130 feet. August 1, 1948. I. M. Newell.

Arctic Ocean, 25 miles north by northeast of Icy Cape, Alaska (latitude 70° 05′ N., latitude 158° 53′ W.) Sand, sponges, and Bryozoa at depth of 250 feet. July 22, 1948. I. M. Newell.

Bering Strait, Alaska (latitude 66° 02′ N., longitude 168° 16′ W.). Sand and gravel at depth of 162 feet. August 3, 1948. I. M. Newell.

Off Cape Prince of Wales, Alaska (latitude 65° 35′ N., longitude 168° 23′ W.). Sand and gravel at depth of 175 feet. August 3, 1948. I. M. Newell.

Kagamil Pass, Islands of the Four Mountains, Alaska (latitude 52° 55′ 30″ N., longitude 169° 43′ 42″ W.). Boulder and gravel bottom at depth of 245 feet. August 14, 1948. I. M. Newell.

Attu Island, Alaska, 1.5 miles northeast of Alexai Point. In coarse sand and gravel, intertidal. June 24, 1948. I. M. Newell.

### **Copidognathus nubilobius,** new species

FEMALE: Body 622 μ long, 421 μ wide, length/width = 1.48 (one specimen). AD (fig. 29) with three elevated areas of prominent rosette pores (fig. 42), each area longer than wide. OC (fig. 31) with two areas of rosette pores, one anterior and one posterior to the posterior cornea. Corneae present, but not distinct. Costae of PD with very prominent rosette pores, the floor of the alveolus usually divided into two to five parts as shown in figure 43. PD also with a lateral row of rosette pores. Those portions of dorsal plates outside of rosette pores marked with porose panels, the canaliculi small and numbering 10 to 20 in each panel. Second pair of dorsal setae in the membranous area. Third pair either in the very margin of PD or in the membranous area adjacent to the plate. Membranous area marked with thin, parallel striae. Ventral plates (fig. 33) quite uniformly marked with prominent rosette pores of the type found on the costae (fig. 24). Genital sclerites heavily sclerotized and sculptured (fig. 41). GA appearing slightly cinctured along a transverse line just anterior to the genital opening.

Rostral sulcus (fig. 30) extending to or beyond the level of the third (first long) pair of maxillary setae, which lie 0.18 to 0.20 of the length of the sulcus from the posterior end of the sulcus (one female, two males). Rostrum not reaching to end of P-2. Base of capitulum with prominent rosette pores (fig. 28, male). Palpi and chelicerae as shown in figures 38 and 39 (male).

I-3 and II-3 (figs. 35, 34, male) swollen, 1.45 and 1.53 times as long as high, respectively. All basifemora, femora, III-1, and IV-1 with depressed porose panels, oval in form, the canaliculi

CHAETOTAXY OF LEGS

| | I | | | | II | | | | III | | | | IV | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d. | v. | l. | m. | d. | v. | l. | m. | d. | v. | l. | m. | d. | v. | l. | m. |
| 1 | — | — | — | 1 | — | — | — | 1 | — | 1 | — | — | — | — | — | — |
| 2 | 1 | 1 | — | — | 1 | 1 | — | — | 1 | 1 | — | — | 1 | 1 | — | — |
| 3 | 3 | 1 | 1 | — | 3 | 1 | 1 | — | 2 | 1 | — | — | 2 | 1 | — | — |
| 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | — | 1 | 1 | 1 | — |
| 5 | 3 | 1 | 1 | 2 | 3 | 1 | 1 | 2 | 2 | 2 | 1 | — | 2 | 2 | 1 | — |
| 6 | 3 | 3 | — | — | 3 | — | — | — | 4 | — | — | — | 3 | — | — | — |

numerous but very delicate. Other segments of legs with numerous fine canaliculi but no panels. III-3 and IV-3 with a ventral seta. Ventromedial seta of both III-5 and IV-5 short, flattened, prominently pectinate, inflexible (fig. 37), unlike most species seen by the writer in which the one on IV-5 is long, smooth, slender, and usually flexible. III-6 with four, IV-6 with three, dorsal setae, the two on III-6 very close together. The distance from the base of the segment to the first seta of III-6 is 4.2 to 4.6 times as great as the distance from the first seta to the level of the second (two specimens). Alveolus of ventral and medial setae of I-5 guarded by a spiniform cuticular projection (fig. 32). Tarsi I and II with a small claw fossa, III and IV with no appreciable fossa. Fossal membranes virtually absent, although very small ones are evident on I-6. Lateral claws of all legs pectinate, median claw bidentate and well developed. Bacillum and parambulacral setae as in other species of the genus.

MALE: Resembling the female in all respects except the characters of GA. The only specimen in position for observation had both third dorsal setae in the margin of PD. Genital opening surrounded by 30 to 31 setae on each side (two specimens). Genital sclerites unique in the genus, there being five pairs of setae (figs. 27, 40) in the only two specimens available. First three pairs of genital setae slender, flexible, fourth pair spiniform, fifth pair bifurcate in three out of four cases seen.

REMARKS: This species is described from specimens from Adak Island, Alaska. While somewhat better material is available from Kodiak, the Adak specimens are larger, more distinctly sculptured, and darker, indicating that these are probably more typical. The writer has observed in the course of his experience that individuals of a particular species are larger, have a thicker and more deeply pigmented cuticle, and more prominent panels and pores in that region in which they are found most frequently

and in greatest abundance. This species is variable in the position of the third dorsal setae, and perhaps a sexual difference would be found in that character if a larger series were available. Certainly one of the most unusual features is the presence of three pairs of setae on the anterior half of the genital sclerites of the male, in marked contrast to all other species of the genus known to the author. Since only two specimens are available, the likelihood that this is an anomaly is not excluded, although it is certainly small. In *Copidognathus gigas*, new species, these setae typically number two pairs, but individuals with two and one-half pairs are also common, and one specimen with three pairs was found. In a series of 13 males of that species, the frequency of the three arrangements was as follows: six with two pairs, six with two and one-half pairs, one with three pairs.

DISTRIBUTION: Adak Island, Aleutian Islands, Alaska (Clam Lagoon), on *Enteromorpha* near mouth of small creek, female holotype. July 5, 1948. I. M. Newell.

Kodiak Island, Alaska, Nyman Peninsula, on *Mytilus* and algae. October 11, 1947. Gary and Helen Daetz.

## **Copidognathus thomasi** Newell, 1950

NEW RECORDS: Unalaska Island, Alaska; Dutch Harbor. Sand and gravel under large stones, and on rocks covered with *Balanus* and algae, intertidal. August 9, 1948. I. M. Newell.

Kagamil Pass, Islands of the Four Mountains, Alaska (latitude 52° 55′ 30″ N., longitude 169° 43′ 42″ W.). Boulder and gravel bottom at depth of 245 feet (one specimen). August 14, 1948. I. M. Newell.

Attu Island, Alaska; Murder Point and Alexai Point, intertidal. June, 1948. I. M. Newell.

## **Copidognathus unalaskensis,** new species

Figures 44–56

This species is closely related to *C. thomasi* Newell, 1950, and it is described largely by comparison with that species. It has been taken only at Dutch Harbor, Alaska, where the two species occur together.

FEMALE: Smaller than *C. thomasi*, body (fig. 49) 518 to 551 $\mu$ long, 298 to 330 $\mu$ wide, length/width = 1.59 to 1.74; average of five specimens 533 by 320 $\mu$, length/width = 1.67. Paneling and

sclerotization of both dorsal and ventral surfaces much more feeble than in *C. thomasi.* Anterior and posterior porose areas of AD only vaguely delimited, although always present. Second pair of dorsal setae in membranous area. Third pair of dorsal setae also in membranous area (no exceptions in 20 or more specimens of both sexes), unlike *C. thomasi* in which these have invariably been found in the margin of PD. Costae of PD three to four rosette pores wide, margins of PD also with a band of rosette pores, two to three pores wide, as in *C. thomasi,* the lateral bands coalescing with the costae anteriorly. Corneae of OC feebly developed or absent; posterior angle of OC usually more acute than in *C. thomasi,* in some cases slightly caudiform (fig. 55); cuticle marked with a few porose panels or feebly developed rosette pores. Membranous area variable in extent, PD extending well up between ocular plates in young adults, but not so far in the older ones.

Ventral plates (fig. 44) uniformly marked with distinct porose panels, but these are not so well developed as in *C. thomasi.* Membranous area slightly more extensive, anterior pair of setae of GA much nearer anterior margin of plate. The latter difference is only in part a result of the slightly smaller size of the plate, for the distance from the first to the second seta is nearly equal to the distance from the second to the third; whereas in *C. thomasi,* these respective distances are in the ratio of about 1:2. Cervical processes absent from AE. Genital opening and ovipositor as in *C. thomasi.*

Rostral sulcus (fig. 54) 0.61 to 0.78 as long as rostrum, average 0.70; first pair of long maxillary setae 0.15 to 0.21 of the length of the sulcus from the posterior end of the sulcus, average 0.18 (three females). Three males gave slightly different values, these being, respectively, 0.61 to 0.75, average 0.68; 0.10 to 0.13, average 0.11. The first pair of long maxillary setae are distinctly nearer the end of the sulcus than in *C. thomasi,* even in the female. Palpi and chelicerae as shown in figures 48 and 52 (male).

Legs (figs. 45–47) not paneled except for several areas of porose panels distributed as follows: ventrally to laterally on I-3 and II-3, ventrolaterally on I-5 and II-5, ventrally to ventrolaterally on III-3 and IV-3. The porose panels have weakly defined walls, if any, the pores being relatively coarser and fewer in number than in *C. thomasi,* and sometimes arranged in groups of three to seven pores (fig. 50). Femora I and II slightly thicker than in *C. thomasi,* 2.00 and 2.05 times as long as high in the one specimen

measured. Number and arrangement of setae precisely as given for *C. thomasi*, with the one important exception that III-6 has only three setae dorsally rather than four. Ventral and medial setae of I-5 and II-5 without a cuticular projection near the alveolus.

MALE: Resembling the female in most respects except the following: Body 492 to 536 $\mu$ long, 298 to 318 $\mu$ wide, length/width = 1.55 to 1.74; averages of five specimens 513 by 310 $\mu$, length/width = 1.64. Base of capitulum (fig. 53) with two pairs of setae rather than the single pair normally found here. Genital opening (fig. 51) surrounded by about 45 to 70 setae (five specimens); chitinous shelf behind genital opening not so distinctly developed as in *C. thomasi*, and absent in some cases. Setae of genital sclerites as shown in figure 56.

REMARKS: The relationship between *C. unalaskensis*, new species, and *C. thomasi* Newell is so close that their origin from a common stock is beyond reasonable doubt. Yet they differ completely in several characters: the position of the third pair of dorsal setae, position of the anterior setae of GA of the female, the position of the first long pair of maxillary setae, the number of setae on the base of the capitulum of the male, the spines at the base of the ventral and medial setae of I-5 and II-5, the paneling of the femora, and the number of dorsal setae on III-6. Any one of these characters alone can be used to distinguish one species from the other in the very large series that the writer has examined.

DISTRIBUTION: Dutch Harbor, Unalaska Island, Alaska, male holotype. Sand and gravel under large stones in tide zone. August 9, 1948. I. M. Newell.

### **Copidognathus aurorae** Newell, 1951

Figure 57

NEW RECORDS: Attu Island, Alaska; Theodore Point. Dredged from rocky bottom, August 20, 1948. I. M. Newell.

Oglala Pass, Rat Islands, Alaska. Bryozoa, sponges, Hydrozoa, at depth of 180 feet. August 20, 1948. I. M. Newell.

Adak Island, Alaska; Rocky Point. July 4, 1948. I. M. Newell.

Kagamil Pass, Islands of the Four Mountains, Alaska. Boulders and gravel at depth of 245 feet. August 14, 1948. I. M. Newell.

Unimak Pass, Aleutian Islands, Alaska. Dredged from bottom. August 11, 1948. I. M. Newell.

St. Paul Island, Alaska. Intertidal, on algae. June 29, 1946. V. B. Scheffer.

Bering Sea, 42 miles north by northeast of St. Paul Island, Alaska (latitude 57° 44′ N., longitude 169° 42′ W.). Mud and sand at depth of 245 feet. August 6, 1948. I. M. Newell.

Bering Sea, about 90 miles northeast of St. Paul Island, Alaska (latitude 58° 13′ N., longitude 169° 16′ W.). Muddy sand at depth of 250 feet. August 5, 1948. I. M. Newell.

Bering Sea, 40 miles south by southeast of Cape Prince of Wales, Alaska (latitude 65° 02′ N., longitude 167° 30′ W.). Muddy sand and gravel, ascidians. August 3, 1948. I. M. Newell.

Off Cape Prince of Wales, Alaska (latitude 65° 35′ N., longitude 168° 23′ W.). Sand and gravel at depth of 175 feet. August 3, 1948. I. M. Newell.

Bering Strait (latitude 66° 02′ N., longitude 168° 16′ W.). Shells, sand, gravel, at depth of 162 feet. August 3, 1948. I. M. Newell.

Arctic Ocean, 18 miles nothwest of Wainwright, Alaska (latitude 70° 53′ N., longitude 160° 05′ W.). Sand and gravel at depth of 130 feet. August 1, 1948. I. M. Newell.

Arctic Ocean, 60 miles southwest of Barrow, Alaska (latitude 71° 05′ N., longitude 158° 53′ W.). Sponges, Bryozoa, sand, at depth of 250 feet. July 22, 1948. I. M. Newell.

Remarks: In some specimens (fig. 27), the ocular plates are more pointed than indicated in the original description, but these individuals are not common. The specimen drawn is from St. Paul Island, Bering Sea.

### **Copidognathus gigas,** new species

Figures 58–69

Female: Body 823–855 $\mu$ long, 544–603 $\mu$ wide, length/width = 1.46, averages of three specimens 836 by 577 $\mu$, length/width = 1.46. AD (fig. 68) very weakly paneled outside of the three elevated areas which are marked by porose panels (fig. 59) and not rosette pores. The posterior porose areas are completely separated in some specimens, but slightly coalesced in others. Second and third pairs of dorsal setae in the membranous area.

OC with a patch of porose panels in the vicinity of the eye spots; corneae poorly developed or absent. Costae of PD three to five porose panels wide; a narrow band of porose panels along the margins of the plate. Costae somewhat swollen anterior to the fifth pair of dorsal setae, at which point is the usual pore. Remainder of PD faintly paneled. Membranous area extensive, especially in the more replete individuals. Ventral surface as shown in figure 69. Epimeral processes absent. GA with three, three and one-half, or four pairs of ventral setae, exclusive of the ones on the anal papilla. Genital sclerites with a single pair of setae.

Palpi as in male (fig. 64). Rostral sulcus (fig. 65) 0.77 to 0.78 times as long as rostrum, first pair of long maxillary setae 0.0 to 0.18 times the length of the sulcus from the posterior end of the sulcus (three specimens). In one specimen, the sulcus was unusually short, occupying only 0.74 of the interval between the tip of the rostrum and the first pair of long setae. One female had two pairs of setae on the base of the capitulum. All femora faintly reticulate (fig. 66); patella, tibia, and tarsus with numerous coarse canaliculi. Femora I and II 1.88 and 2.14 times as long as high, respectively. Median claw very heavy, dorsal tooth small; lateral claws pectinate. Claw fossa weakly developed, absent from IV-6; lamellae absent. Medial setae of tibiae I to III pectinate. Chaetotaxy showing no special features, except that both III-3 and IV-3 have a ventral seta; divaricate parambulacral setae and bacillum of legs I and II typical for genus; medial setae of tibiae I to III pectinate. Both III-6 and IV-6 with four setae dorsally. Lateral claws only faintly pectinate. Median claw of all legs unidentate.

Chaetotaxy of Legs

| | I | | | | II | | | | III | | | | IV | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d. | v. | l. | m. | d. | v. | l. | m. | d. | v. | l. | m. | d. | v. | l. | m. |
| 1 | — | — | — | 1 | — | — | — | 1 | — | 1 | — | — | — | — | — | — |
| 2 | 1 | 1 | — | — | 1 | 1 | — | — | 1 | 1 | — | — | 1 | 1 | — | — |
| 3 | 3 | 1 | 1 | — | 3 | 1 | 1 | — | 2 | 1 | — | — | 2 | 1 | — | — |
| 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | — | — | 2 | 1 | — | — |
| 5 | 3 | 1 | 1 | 2 | 3 | 1 | 1 | 2 | 2 | 2 | 1 | — | 2 | 2 | 1 | — |
| 6 | 3 | 3 | — | — | 3 | — | — | — | 4 | — | — | — | 4 | — | — | — |

Male: Body 752–901 μ long, 499–583 μ wide, length/width = 1.45–1.56; average of five specimens 804 by 538 μ, length/width =

1.50. Resembling female in most respects except for characters of capitulum and GA. Base of capitulum (fig. 67) typically with two pairs of setae, but these vary considerably in number, the full range probably being from one to three pairs. GA with 23 to 29 setae on each side of genital opening. Genital sclerites with four pairs of inflexible spiniform setae, the anterior two pairs the more slender; anterior group sometimes containing five and even six setae.

Remarks: This is the largest species of the genus yet described, approaching nearly 1 mm. in length, and exceeding the maximum length of *Copidognathus thomasi* Newell by about 220 $\mu$. The relationship to other species in the genus is obscure, although the species possesses a number of characters in common with *C. aurorae* Newell and *C. curtus*. The presence of a ventral seta on III-3 as well as IV-3 is a character completely unknown in any other North American species seen by the writer, except *C. nubilobius*, although present in *Copidognathus dentatus* Viets, 1940, and *C. humerosus* Trouessart, 1896 (see Viets, 1940, pp. 35, 43). While this may appear to be an insignificant character, the value of a morphological character in determining similarities or differences between species must be judged on its persistence within the species. The chaetotaxy of III-3 and IV-3 in the genus *Copidognathus* shows only three different arrangements, as follows, listed in what at present appears to be the order of decreasing frequency in the genus.

| | III-3 | | | | IV-3 | | | |
|---|---|---|---|---|---|---|---|---|
| | d. | v. | l. | m. | d. | v. | l. | m. |
| a | 2 | — | — | — | 2 | — | — | — |
| b | 2 | — | — | — | 2 | 1 | — | — |
| c | 2 | 1 | — | — | 2 | 1 | — | — |

Distribution: Adak Island, Alaska, 1.5 miles north of Zeto Point, male holotype. Red algae and kelp. July 5, 1948. I. M. Newell.

Adak Island, Alaska, 2.5 miles southwest of Cape Adagdak. July 5, 1948. I. M. Newell.

Attu Island, Alaska, 1 mile west of Murder Point. On coralline algae. June 25, 1948. I. M. Newell.

Attu Island, Alaska, 1.5 miles northeast of Alexai Point. On mixed red algae. June 24, 1948. I. M. Newell.

## **Copidognathus diaphaneus,** new species

Figures 70–82

FEMALE: Body 350 to 408 $\mu$ long, 175–233 $\mu$ wide, length/width = 1.74–2.00; average of five specimens 380 by 206 $\mu$, length/width = 1.85. AD (figs. 80, 81) rather uniformly covered with porose panels, the canaliculi small, the panels indistinct. Second pair of dorsal setae in membranous area, third pair in PD. OC as shown in figure (male), corneae usually present. PD, like other plates, thin, weakly paneled, with poorly developed costae which are sometimes confined to the posterior two-thirds of the plate. Porose panels similar in form to those on AD. Ventral plates (fig. 78) appearing almost smooth under low power, marked with numerous fine canaliculi under high power. Paneling evanescent or absent. Epimeral processes small but well formed. The six structures shown near the middle of AE are internal apodemes. These are found in the same position in all species of *Copidognathus*, but they show up unusually well in species with a delicate, smooth cuticle such as this species has. GA pyriform, rounded anteriorly.

Rostral sulcus (fig. 73) 0.59 to 0.64 times as long as rostrum, average 0.62; first pair of long maxillary setae 0.25 to 0.29 of the length of the sulcus from the posterior end of the sulcus, average 0.27 (three specimens). Base of capitulum and most of rostrum marked with fine canaliculi but no panels. Palpi and chelicerae as in figures 72 and 77 (male). Chaetotaxy of legs (figs. 74–76) precisely as given for *Copidognathus arcticus* except for slight differences in the arrangement of the setae of some segments. Femora I and II feebly paneled. All segments of all legs except the distal portion of the tarsi with scattered canaliculi. Femora I and II greatly swollen, 1.50 and 1.56 times as long as high, respectively. Medial setae of I-5 and II-5 pectinate; ventromedial seta of III-5 pectinate, its homologue on IV-5 smooth, tapering. Tarsi I and II with a small claw fossa, but no lamellae of note; tarsi III and IV with neither fossa nor lamellae. Bacillum and parambulacral setae typical for the genus. Dorsal setae of III-6 (fig. 76) widely separated, the distance from the base of the tarsus to the first dorsal seta only 0.92 to 1.35 times as great as the distance from the first seta to the level of the second (three tarsi). Lateral claws not pectinate, even under oil immersion, but with a distinct accessory tooth, which may be simple or

comprised of three to five minute teeth, visible under oil immersion. Median claw bidentate.

CHAETOTAXY OF LEGS

| | I | | | | II | | | | III | | | | IV | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d. | v. | l. | m. | d. | v. | l. | m. | d. | v. | l. | m. | d. | v. | l. | m. |
| 1 | — | — | — | 1 | — | — | — | 1 | — | 1 | — | — | — | — | — | — |
| 2 | 1 | 1 | — | — | 1 | 1 | — | — | 1 | 1 | — | — | 1 | 1 | — | — |
| 3 | 3 | 1 | 1 | — | 3 | 1 | 1 | — | 2 | — | — | — | 2 | — | — | — |
| 4 | 2 | 1 | — | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | — | 2 | 1 | — | — |
| 5 | 3 | 1 | 1 | 2 | 3 | 1 | 1 | 2 | 2 | 2 | 1 | — | 2 | 1 | 1 | 1 |
| 6 | 3 | 3 | — | — | 3 | — | — | — | 4 | — | — | — | 3 | — | — | — |

MALE: Resembling female in all respects except characters of GA (fig. 70). Surface of plate covered with faintly delimited porose panels, the canaliculi numerous and fine. Genital opening surrounded by 12 to 16 setae on each side. Genital sclerites as shown in figure 71. Proximal maxillary setae not duplicated.

REMARKS: The affinities of this species are questionable. It appears to resemble *Copidognathus extensus* Viets, 1940, in a number of respects, but its similarity to that species is by no means so great as the similarity between *C. extensus* and *C. pachypus* Newell, 1947. One dissected male was of considerable value in providing a picture of the structure of the chelicera of the Halacaridae. The chelicera (fig. 82) was drawn in ventral view, the digitus fixus being stippled, the tarsus or digitus mobilis unshaded, and below the latter a sharp pointed membrane (shown by hatching in the figure). This membrane is visible in lateral view also, but it is almost impossible to ascertain in lateral view whether or not it largely envelops the base of the movable digit. The material available here shows that it does not, but is a simple pointed structure lying free just under the tarsus.

DISTRIBUTION: Bering Sea, 42 miles north by northeast of St. Paul Island, Alaska (latitude 57° 44′ N., longitude 169° 42′ W.), male holotype. Mud and sand at depth of 245 feet. August 6, 1948. I. M. Newell.

Bering Sea, 90 miles northeast of St. Paul Island, Alaska (latitude 58° 13′ N., longitude 169° 16′ W.). Mud and sand at depth of 250 feet. August 5, 1948. I. M. Newell.

Attu Island, Alaska, Theodore Point (latitude 52° 45′ N., longitude 172° 40′ E.). Dredged from rocky bottom. August 20, 1948. I. M. Newell.

Attu Island, Alaska, 1 mile west of Murder Point. On coralline red algae. June 25, 1948. I. M. Newell.

### **Copidognathus vulcanis** Newell, 1951

NEW RECORD: Attu Island, Alaska; Theodore Point. Dredged from rocky bottom. August 20, 1948. I. M. Newell.

REMARKS: The six specimens from Theodore Point resemble very closely the typical forms described from Kagamil Pass. The paneling is distinct, and the dorsal setae quite long, although not so long as in the type series. Also, the median angle of the ocular plate is relatively sharp, as was noted in the smaller forms from Kagamil Pass.

### **Copidognathus punctatus** Newell, 1950

Figures 83–85

NEW RECORDS: Kodiak Island, Alaska; Kalsin Bay and Woman's Bay. September–October, 1947. Gary and Helen Daetz.

Adak Island, Alaska; Rocky Point, Clam Lagoon, and Cape Adagdak. All intertidal. July, 1948. I. M. Newell.

Attu Island, Alaska; about 1 mile west of Murder Point. On coralline red algae. June 25, 1948. I. M. Newell.

REMARKS: No dorsal view of this species was given in the original description, so one is presented here (fig. 83), with a detailed drawing of AD (fig. 84). A comparison of figures 84 and 87 will show the difference in cuticular details between *C. punctatus* and *C. parapunctatus*. Both species resemble closely *C. rhodostigma* (Gosse), 1855, and *C. aequalivestitus* Viets, 1950. Both of these species, however, appear to be marked with distinct porose panels, while in *C. punctatus* the canaliculi are uniformly distributed over the plates, or the paneling is feebly developed at most (fig. 85). Even the description of *C. aequalivestitus*, coming as late as it does, is not sufficiently detailed to give a clear picture of the nature of the cuticular markings which are so important in deciding whether or not a new species is involved. Throughout the course of the studies on the Alaskan species of *Copidognathus* the writer has been impressed by the difficulty of separating certain forms, even when material was available for direct comparison. The task becomes even more difficult when one attempts to compare a form from one region with an incomplete

description of an obviously related species from another part of the world. One real difference between *C. punctatus* and *C. aequalivestitus* from the Falkland Islands that can be gleaned from the original description of the latter is that the posterior pairs of setae of the genital sclerites of the male of *C. aequalivestitus* are long, slender, and probably flexible, while in *C. punctatus* they are spiniform and inflexible. Furthermore, the dorsal setae of III-6 are widely spaced in Viets' species. There also appears to be a difference in the extent of the membranous area. However, others could probably be found by a direct comparison of the two.

*Copidognathus aequalivestitus* seems to resemble *C. parapunctatus* in the sculpturing and spacing of the plates, but the form of AD and the proportions of the femora indicate a closer relationship to *C. punctatus*. Viets' consideration of the similarities between *C. aequalivestitus* and *C. caudani* (Trouessart), 1896, was purely gratuitous, for the wide spacing of the dorsal plates and the large number of setae on GA in the male of *C. caudani* show that it belongs in an entirely different species group, probably being more closely related to *C. fabriciusi* (Lohmann), 1889, and *C. aurorae* Newell, 1951.

### **Copidognathus parapunctatus** Newell, 1950

Figures 86–89

New Records: Attu Island, Alaska; Theodore Point. Dredged from rocky bottom. August 20, 1948. I. M. Newell.

Attu Island, Alaska; Murder Point and Alexai Point. Intertidal. June 25, 1948. I. M. Newell.

St. Paul Island, Alaska. Intertidal, on algae. June 29, 1946. V. B. Scheffer.

Adak Island, Alaska; Cape Adagdak and Zeto Point. Intertidal. July 5, 1948. I. M. Newell.

Kagamil Pass, Islands of the Four Mountains, Alaska. Boulder and gravel bottom at depth of 245 feet. August 14, 1948. I. M. Newell.

Yaquina Head, Oregon (latitude 44° 41′ N., longitude 124° 06′ W.). Intertidal, on coralline algae. February 2, 1947. I. M. Newell.

Remarks: Additional illustrations are provided here to supplement the single figure that was presented in the original description. It can be seen from figure 86 that the female of *Copidog-*

*nathus parapunctatus* is very similar to that of *C. punctatus* in ventral view, the only outstanding difference being that the genital opening is situated somewhat more anteriorly. Also, the anal papilla is definitely angular in outline, usually bearing small keels. The ventral plates are marked with porose panels, but rosette pores are never present. Figures 88 and 89 show the thick femora and the dorsal setae of III-6 which also serve to distinguish *C. punctatus* and *C. parapunctatus*, as pointed out in the original description (Newell, 1950, p. 13). The chaetotaxy of the legs is the same as given for *C. punctatus*. *C. parapunctatus* is the smaller species, as can be seen in the table below:

| | Length, $\mu$ | Width, $\mu$ | Length/Width |
|---|---|---|---|
| *C. punctatus* (from Adak) | | | |
| 4 males | 408–415, av. 410 | 220–246, av. 235 | 1.66–1.85, av. 1.75 |
| 9 females | 382–434, av. 410 | 227–253, av. 237 | 1.64–1.80, av. 1.74 |
| *C. parapunctatus* (from Attu) | | | |
| 4 males | 318–330, av. 324 | 188–194, av. 192 | 1.63–1.72, av. 1.68 |
| 4 females | 324–337, av. 327 | 188–207, av. 194 | 1.62–1.72, av. 1.68 |

## **Copidognathus arcticus,** new species

Figures 90–104

Male: Body (fig. 96) 350–382 $\mu$ long, 220–240 $\mu$ wide, length/width = 1.50–1.64; average 363 by 230 $\mu$, length/width = 1.58 (six specimens). AD (fig. 97) with a posterior elevated area, semi-elliptical in form, the area outlined by a band of rosette pores, three to four pores wide. The rosette pores have gaping ostia; the canaliculi are small and mostly restricted to the periphery of the pores. Centrally, the elevated area is marked with panels having a few scattered canaliculi. Anterior elevated area with similar rosette pores or sometimes porose panels, having weakly developed canaliculi; essentially confluent with the posterior area, although the pores or panels in the region of the fusion are of a slightly different character. OC (fig. 90, dissected) usually with two well-developed corneae, and two refractile spots, one rod-shaped, one circular, lateral to the posterior cornea. Remainder of plate sharply paneled and with numerous canaliculi. Anterior half of costae of PD with porose panels, grading into true rosette pores with small circular ostia in the posterior half.

A marginal row of porose panels is present, but not so distinct as the costae. Intervening areas distinctly marked with deeply impressed panels, and with scattered, large, highly refractile canaliculi (fig. 91), which are especially frequent around the margins of the panels. Membranous areas in nearly all specimens quite extensive, especially in the older adults.

Ventral plates (fig. 94), especially AE and GA, with distinct porose panels (fig. 98). AE with cervical processes. Panels lateral to genital opening and anterior to the insertions of legs III and IV deeply depressed and approaching rosette pores in form. Ventral plates moderately spaced. Genital opening surrounded by 20 to 24 setae, with usually 11 on each side. All setae of genital sclerites stiff, inflexible, but the posterior ones longer and heavier than the anterior two pairs (fig. 95).

Rostral sulcus (fig. 92) 0.57 to 0.66 times as long as rostrum, average 0.61, first long pair of maxillary setae 0.30 to 0.36 of the length of the sulcus from the posterior end of the sulcus, average 0.34 (three males). Rostrum reaching nearly to or slightly beyond level of disti-dorsal end of P-2. Palpi as shown in figure 99.

Chaetotaxy of Legs

| | I | | | | II | | | | III | | | | IV | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d. | v. | l. | m. | d. | v. | l. | m. | d. | v. | l. | m. | d. | v. | l. | m. |
| 1 | — | — | — | 1 | — | — | — | 1 | — | 1 | — | — | — | — | — | — |
| 2 | 1 | 1 | — | — | 1 | 1 | — | — | 1 | 1 | — | — | 1 | 1 | — | — |
| 3 | 3 | 1 | 1 | — | 3 | 1 | 1 | — | 2 | — | — | — | 2 | — | — | — |
| 4 | 2 | 1 | — | 1 | 2 | 1 | 1 | — | 1 | 1 | 1 | — | 2 | 1 | — | — |
| 5 | 3 | 1 | 1 | 2 | 3 | 1 | 1 | 2 | 2 | 2 | 1 | — | 3 | 2 | — | — |
| 6 | 3 | 3 | — | — | 3 | — | — | — | 4 | — | — | — | 3 | — | — | — |

In addition to the setae shown in the table, there are the usual parambularal setae and bacillum which are normal in form and position. I-3 rather distinctly paneled (fig. 102), other femora moderately roughened, but not especially paneled. Trochanter, basifemur, and femur of all legs with a few scattered canaliculi of moderate size, especially on legs I and II. Femora I and II swollen, 1.78 and 1.79 times as long as high. The dorsal setae on the basal portion of III-6 widely separated, the distance from the base of the segment to the level of the first seta only 1.34 to 1.39 as great as the distance from the first seta to the level of the second (two specimens). I-6 and II-6 with claw fossa, but with

weakly developed lamellae. III-6 and IV-6 (figs. 102, 104) with neither lamellae nor fossa of any note.

FEMALE: Resembling the male except in the characters of GA (fig. 93). Genital opening displaced posteriorly. Ovipositor not reaching to middle of interval between genital opening and anterior margin of plate.

REMARKS: There are no known absolute characters by which this species can be separated from *Copidognathus vulcanis* Newell, although it seems certain that they are distinct. The only character in which the two forms have not been found to approach each other very closely at one time or another is in the degree of development of the claw fossa and lamellae (figs. 103, 104). To study these structures, it is essential that the tarsus be viewed in lateral view, for when seen even partially rotated, lamellae usually appear to be present. At the present, distribution can be used as a presumptive aid in differentiating between the two forms, for *C. vulcanis* has not been found on the Bering Sea or Arctic Ocean bottom, while *C. arcticus* has not appeared in any collection from the Aleutians. Both are found in subtidal waters.

DISTRIBUTION: Arctic Ocean, 110 miles north of Cape Prince of Wales, Alaska (latitude 67°, 10′ N., longitude 167° 50′ W.), at depth of 144 feet, female holotype. August 1, 1948. I. M. Newell.

Arctic Ocean, 25 miles north by northeast of Icy Cape, Alaska (latitude 70° 42′ N., longitude 161° 25′ W.), at depth of 160 feet. August 1, 1948. I. M. Newell.

Arctic Ocean, 18 miles northwest of Wainwright, Alaska (latitude 70° 53′ N., longitude 160° 05′ W.). Sand and gravel at depth of 130 feet. August 1, 1948. I. M. Newell.

Arctic Ocean, 60 miles southwest of Barrow, Alaska (latitude 71° 05′ N., longitude 158° 53′ W.). Sponges, Bryozoa, and sand at depth of 250 feet. July 22, 1948. I. M. Newell.

Bering Strait, off Cape Prince of Wales, Alaska (latitude 65° 35′ N., longitude 168° 23′ W.). Sand and gravel at depth of 175 feet. August 3, 1948. I. M. Newell.

Bering Strait, Alaska (latitude 66° 02′ N., longitude 168° 16′ W.). Shells, sand, and gravel at depth of 162 feet. August 3, 1948. I. M. Newell.

Bering Sea, about 90 miles northeast of St. Paul Island, Alaska (latitude 58° 13′ N., longitude 169° 16′ W.). Muddy sand at depth of 250 feet. August 5, 1948. I. M. Newell.

Bering Sea, about 42 miles north by northeast of St. Paul Island, Alaska (latitude 57° 44′ N., longitude 169° 42′ W.). Mud and sand at depth of 245 feet. August 6, 1948. I. M. Newell.

### **Copidognathus similis,** new species

Figures 105–112

MALE: Resembling *Copidognathus arcticus,* new species, in so many details as to be virtually indistinguishable in most respects. Body size distinctly greater, 402 to 460 μ long, 266–305 μ wide, length/width = 1.48–1.66, average 441 by 285 μ, length/width = 1.55 (six specimens). Dorsal plates essentially as described for *C. arcticus,* the differences between individuals of either species being nearly as great as any differences between the species as a whole. One consistent difference to which no exceptions have yet been found is that the costae of PD bear rosette pores throughout their length, while in *C. arcticus* these are found only in the posterior half (figs. 91, 106). Second pair of dorsal setae in the membranous area between AD and OC. GA distinctly more rectangular in the anterior half, and membranous areas more restricted (fig. 111). Genital opening with 10 to 13 setae on each side. Setae of genital sclerites as in *C. arcticus.* Capitulum as in *C. arcticus* except for greater size. Rostral sulcus 0.55 to 0.61 times as long as rostrum, average 0.57; first pair of long maxillary setae 0.23 to 0.38, average 0.29, of the length of the sulcus from the posterior end of the sulcus (three males). Femur I slightly more slender in the two specimens measured (length/height = 1.85, 1.93) than in the three specimens of *C. arcticus* (these were dissected legs). Legs (figs. 107 to 110) darker, more heavily punctate and paneled than in *C. arcticus.* Chaetotaxy as in *C. arcticus* except for IV-6, which has four setae dorsally rather than three (fig. 107). The proximal dorsal setae of III-6 and IV-6 are widely spaced. Lamellae virtually absent. Lateral claws of I-6 appearing smooth at low magnifications, but pectinate under oil; those of II-6, III-6, and IV-6 with weakly developed comb, visible at a magnification of 800.

FEMALE: Body 447–454 μ long, 285–311 μ wide, length/width = 1.44–1.59, average 449 by 305 μ, length/width = 1.50 (three specimens). Resembling the male in all respects except the characters of GA (fig. 112).

REMARKS: While *Copidognathus arcticus* and *C. similis* re-

semble each other in great detail, they can usually be separated quickly and positively even without resorting to the absolute difference in number of dorsal setae on IV-6. *C. similis* is a more robust species, and the heavier paneling and punctations of the legs give it a darker appearance. These characters are further augmented by the relative extent of the membranous areas and the difference in form of the anterior margin of GA (figs. 94, 111). The latter character is subject to variation, however, not only in the two species involved here, but in others as well. Hence it must be used with care, for complete reliance on it will lead to error. The number of dorsal setae on III-6 and IV-6 is the ultimate criterion available for distinguishing these two forms; without it, there would be considerable doubt as to whether these were distinct species or only varieties. Variance in the character is extremely low. The fact that such a difference is found in very closely related forms like these, or like *Copidognathus kagamili* Newell, 1950, and *C. hummelincki* Viets, 1936, shows that while variations in this character are of great utility at the species level, they have no significance whatever beyond that.

DISTRIBUTION: Arctic Ocean, 110 miles north of Cape Prince of Wales, Alaska (latitude 67° 10′ N., longitude 167° 51′ W.), male holotype. At depth of 144 feet. August 1, 1948. I. M. Newell.

Arctic Ocean, 18 miles northwest of Wainwright, Alaska, (latitude 70° 53′ N., longitude 160° 05′ W.). Sand and gravel at depth of 130 feet. August 1, 1948. I. M. Newell.

Arctic Ocean, 35 miles southeast of Point Hope, Alaska (latitude 67° 56′ N., longitude 167° 30′ W.). Sand at depth of 150 feet. August 3, 1948. I. M. Newell.

Bering Strait, Alaska (latitude 66° 02′ N., longitude 168° 16′ W.). Shells, sand, and gravel at depth of 162 feet. August 3, 1948. I. M. Newell.

Bering Sea, Port Clarence, Teller, Alaska (latitude 65° 18′ N., longitude 166° 30′ W.). Gravel and sand at depth of 30 feet. July 15, 1948. I. M. Newell.

### **Copidognathus brevimaxillaris,** new species

Figures 113–123

This species is described from six specimens from the type locality, Kagamil Pass, Islands of the Four Mountains, Aleutian Islands, Alaska.

MALE: The single specimen in good position for measuring was 350 by 240 $\mu$, length/width = 1.46. Rosette pores of AD not on three sharply delimited areas, but arranged in the form of an inverted Y, with the setae at the fork of the Y (fig. 116, female). Pores not distinct, because of the gaping ostia and the numerous small canaliculi which are uniformly distributed over the bottom of, as well as around the periphery of, the alveolus. Plate pyriform, posterolateral margins rounded, posterior margin straight; portions of plate outside of Y covered with porose panels. Second pair of dorsal setae lying in the membranous area between AD and OC. OC with an elevated area, roughly circular, in the vicinity of the almost invisible corneae. OC four-sided, trapezoidal in form, angular posteriorly, with no tail. Third pair of dorsal setae in PD; costae broad, gently arched, about five rosette pores wide, with no prominent thickenings. A narrower band of rosette pores along the sides of PD, confluent, or nearly so, with the costae both anteriorly and posteriorly. Rosette pores differing only very slightly, and in some cases perhaps not at all, from the porose panels which cover the remainder of the plate. AE (fig. 115) with epimeral processes; epimeral pores rather large. PE with one dorsal and three ventral setae.

GA with two patches of weakly defined rosette pores lateral to the genital opening. Remainder of GA, PE, and AD covered with distinct porose panels. Membranous areas greatly restricted on both dorsal and ventral surfaces. Genital opening (fig. 113) surrounded by 22 to 24 setae (11 to 12 on each side). Genital sclerites well developed, anterior two pairs of setae short, tapering throughout their length, posterior two pairs longer and also much heavier, spiniform. Penis extending beyond anterior margin of GA.

Palpi (figs. 122, 123) reaching beyond end of I-4. Rostrum very short, blunt, and broad, not reaching to end of P-2, only about 0.8 times as long as the distance between right and left P-1. Rostral sulcus (fig. 114) 0.73 times as long as rostrum, first pair of long setae 0.27 of the length of the sulcus from the posterior end of the sulcus (one specimen). Fourth pair of maxillary setae well behind insertions of palpi.

I-1 and II-1 scarcely visible in ventral view, hidden by the epimeral processes (fig. 121). Femora with conchoidal paneling, and a few very small canaliculi. Other segments of legs mostly smooth. Femora swollen, I-3 less than 1.67 times as long as high

CHAETOTAXY OF LEGS

| | I | | | | II | | | | III | | | | IV | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d. | v. | l. | m. | d. | v. | l. | m. | d. | v. | l. | m. | d. | v. | l. | m. |
| 1 | — | — | — | 1 | — | — | — | 1 | — | 1 | — | — | — | — | — | — |
| 2 | 1 | 1 | — | — | 1 | 1 | — | — | 1 | 1 | — | — | 1 | 1 | — | — |
| 3 | 3 | 1 | 1 | — | 3 | 1 | 1 | — | 2 | — | — | — | 2 | — | — | — |
| 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | — | 2 | 1 | — | — |
| 5 | 3 | 1 | 1 | 2 | 3 | 1 | 1 | 2 | 2 | 2 | 1 | — | 2 | 2 | 1 | — |
| 6 | 3 | 3 | — | — | 3 | — | — | — | 4 | — | — | — | 3 | — | — | — |

(the only available specimen was slightly rotated). All tarsi with claw fossa and lateral membranes, all lateral claws pectinate and with an apparent accessory tooth. Median claw bidentate. In addition to the setae shown in the table, the usual bacillum and parambulacral setae are found on the tarsi and are normal in form.

FEMALE: Body 343–363 μ long, 233–253 μ wide, length/width = 1.44–1.47 (two specimens only). Essentially similar to the male in all respects except the characters of GA (fig. 119). Ovipositor short, not reaching to middle of interval between genital opening and anterior margin of GA. Setae of genital sclerites rather far removed from anterior margin of opening.

REMARKS: This species is a close relative of *C. brachystomus* Viets, 1940 (Adriatic Sea), and it may prove to be a subspecies of that when more is known of the geographical distribution of the Halacaridae. The two resemble each other closely in size and general facies, as well as in a number of details, such as the form of the rostrum, the absence of a ventral seta on III-3 and IV-3, and the rough paneling of I-3 and II-3. Small differences are apparent, however, in the distribution of rosette pores on AD (evidently in three distinct groups in *C. brachystomus*), the degree of development of the corneae, the form of I-3 (about 1.5 times as long as high in *C. brevimaxillaris*, but 1.9 times in *C. brachystomus*), the form of I-5 and II-5, and the claw fossa of III-6 and IV-6 (lamellae lacking in *C. brachystomus*).

This is the second species of *Copidognathus* from this locality with an undoubted relative in the Adriatic, which raises some very interesting questions about the distribution of these species and the origin of the fauna. Neither *C. brevimaxillaris* nor *C. kagamili* Newell, 1950, is obviously related to any species from the Pacific Coast of the United States or Mexico thus far seen by the writer, which suggests the likelihood of an Indo-West Pacific origin for these species. In fact, we are unable to say much, if

anything, about the geographical distribution of the North Pacific Halacaridae, for scarcely more than a dozen species are known from the large Indo-West Pacific region, the richest region of the world from the standpoint of its marine fauna.

DISTRIBUTION: Kagamil Pass, Islands of the Four Mountains, Aleutian Islands, Alaska (latitude 52° 56′ N., longitude 169° 44′ W.), at depth of 245 feet, male holotype. Boulder and gravel bottom covered with corals, sponges, and Hydrozoa. August 14, 1948. I. M. Newell.

### **Copidognathus punctatissimus** (Gimbel), 1919

Figure 124

REMARKS: This species is not known from Alaskan waters, but only from eastern North America, where it ranges from North Carolina to Rhode Island and probably farther north. An additional figure of the species is included here, to aid in clarifying the structure of the epimeral processes. These were overlooked in the description given by the writer (Newell, 1947, pp. 132 to 138), as well as in the original description by Gimbel. Careful attention should be given to these in future systematic studies, for it is probable that they will provide an additional character of value in determining the relationships between species.

### **Agaue bradypus** Newell, 1949

NEW RECORDS: Kodiak Island, Alaska; Humpback Bank (latitude 57° 34′ N., longitude, 152° 13′ W.). Shells, barnacles, worm tubes, at depth of 205 feet. September, 1948. C. W. Thomas.

Kagamil Pass, Islands of the Four Mountains, Alaska (latitude 52° 55′ 30″ N., longitude 169° 43′ 42″ W.). Boulders and gravel at depth of 245 feet. August 14, 1948. I. M. Newell.

Oglala Pass, Rat Islands, Alaska (latitude 51° 42′ N., longitude 178° 26′ E.). Bryozoa, sponges, Hydrozoa, at depth of 180 feet. August 20, 1948. I. M. Newell.

Attu Island, Alaska, Theodore Point (latitude 52° 45′ N., longitude 172° 40′ E.). Dredged from rocky bottom. August, 1948. I. M. Newell.

REMARKS: Specimens from both Kagamil Pass and Oglala Pass were much larger than those from Crescent City, California, the type locality. Females ranged up to 1166 $\mu$ in body length

(the type specimen was 682 $\mu$ long), and the cuticle was more deeply pigmented. Most specimens had five pairs of bacilliform setae in addition to the parambulacral setae on I-6, but a female from Oglala Pass had only four pairs here, so the observed difference probably has no significance.

### **Agaue longiseta** Newell, 1951

NEW RECORD: Adak Island, Alaska; Rocky Point. On red algae. July 4, 1948. I. M. Newell.

ERRATUM: The cheliceral tarsus of this species was illustrated by the writer (Newell, 1951a, p. 17, fig. 36) but was erroneously ascribed to *Thalassarachna agauiformis*.

### **Actacarus illustrans,** new species

MALE: Body 240–246 $\mu$ long, 110–117 $\mu$ wide, length/width = 2.05–2.23 (three specimens). AD and PD almost completely covering the dorsal surface (fig. 131). OC present, but difficult to see in dorsal view; broader posteriorly than anteriorly. Cornea present (fig. 139) in anterior half of plate. PD devoid of costae. Dorsal plates with very small, scattered canaliculi, but with no trace of paneling. One pair of setae in AD, one between AD and OC, and four pairs in PD, the most posterior pair at the very end of the plate. The position of the last pair of setae has been verified in a dissected specimen in which GA and PD had been cleanly separated, the anal papilla remaining attached to GA. In this case, the last pair of dorsal setae remained with PD. There are no setae on the anal papilla. AE (fig. 133) with three pairs of setae, PE with one seta dorsally and three ventrally, GA with a single pair of setae anterior to the middle of the plate (fig. 131) and a group of 11 on each side of the genital opening (fig. 137). The genital opening drawn is somewhat longer (25 $\mu$) and more pyriform than normal. The opening in other specimens was only 20 $\mu$ long and more triangular in outline. Genital sclerites with two pairs of very delicate setae.

Rostrum sharply pointed, triangular, not reaching to end of P-2, bearing two pairs of long setae. Base of capitulum without setae. Palpi ordinarily straight (figs. 125, 140), not inclined ventrally. P-3 with a spiniform seta medially, P-4 also with a spiniform seta and three slender setae (figs. 130, 138). End of P-4 with a seta closely appressed to the side of the segment.

CHAETOTAXY OF LEGS

| | I | | | | II | | | | III | | | | IV | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | d. | v. | l. | m. | d. | v. | l. | m. | d. | v. | l. | m. | d. | v. | l. | m. |
| 1 | — | — | — | — | — | — | — | — | — | 1 | — | — | — | 1 | — | — |
| 2 | 1 | 1 | — | — | 1 | 1 | — | — | 1 | 1 | — | — | 1 | 1 | — | — |
| 3 | 1[a] | — | — | — | 1 | 1 | — | 1 | 2 | — | — | — | 2 | — | — | — |
| 4 | 2 | 2 | — | — | 1 | 1 | 1 | — | 1 | 1 | 1 | — | 2 | 1 | — | — |
| 5 | 3 | 2 | — | 2 | 3 | 2 | — | — | 1[b] | 2 | — | — | 3 | 2 | — | — |
| 6 | 3 | — | — | 2 | 4 | — | — | — | 4 | — | — | — | 3 | — | — | — |

[a] One specimen had two here.
[b] One specimen had three.

The leg setae are so delicate that it is necessary to use oil immersion to find many of them, and even then not all the setae on any one leg can be located with certainty. Four specimens were examined in constructing the table given above. The more notable features are (1) the absence of the medial seta on I-1 and II-1, (2) the presence of a ventral seta on IV-2, (3) the clavate distidorsal seta of II-6 (fig. 127), flanked by two normal setae, (4) the simple, bacilliform parambulacral setae of I-6 and II-6, and (5) the absence of a bacillum or prebacillum. The legs are devoid of any special sculpturing. All tarsi with a prominent claw fossa, but with membranes reduced or absent, except laterally on I-6. Lateral membrane of I-6 greatly expanded (figs. 126, 128). Paired lateral claws of leg I smooth, those of legs II to IV pectinate. Median claw of all legs small, unidentate.

FEMALE: Essentially the same as described above, except for the characters of GA. Body 227–240 $\mu$ long, 117 $\mu$ wide, length/width = 1.94–2.05 (three specimens). GA as described for *Actacarus pygmaeus* Schulz,1936. Genital opening displaced posteriorly, the genital sclerites nearly concealing the anus in ventral view. Ovipositor occupying about one-third of the interval between the genital opening and the margin of GA. Only two pairs of setae visible in material available, one pair at the level of the anterior end of the genital opening, the other anterior to the middle of the plate.

REMARKS: So many misconceptions about the morphology of *Actacarus* were introduced in Schulz's original description that the genus might be considered virtually unknown. Unfortunately, the errors in the original description have been repeated frequently in the literature (Viets, 1939, pp. 528–529; Vitzthum, 1941, p. 821;

André, 1946, p. 35; Newell, 1947, p. 18). *Actacarus pygmaeus* Schulz, 1936, was described as lacking both ocular plates and corneae. Ocular plates are present and well developed in *A. illustrans*, new species, and there is even a weakly formed cornea. While it is not beyond the realm of possibility that the plates are actually absent in *A. pygmaeus*, it is more probable that Schulz simply did not observe them. In 1933 the same author described *Thalassarachna subterraneus* and completely overlooked the elongate sclerites between PD and PE. These sclerites have roughly four times the area of OC in *A. illustrans* and are in full view on the dorsal surface. The palpi of *A. illustrans* are not so sharply flexed as was indicated for *A. pygmaeus*, and it is likely that examination of more material would show that the palpi of *A. pygmaeus* are normally straighter than in the specimens described by Schulz. Also, the writer believes that examination of *A. pygmaeus* would reveal a seta situated medially on P-3 and that I-5 will probably be found to have paired setae ventrally. These were indicated as absent in *A. pygmaeus*.

There is considerable doubt in the writer's mind about the systematic position of the genus. Heretofore it has been regarded as very closely related to the Rhombognathinae. It was on this basis that the writer (1947, p. 18) assumed that a carpite was present in the tarsus, an assumption that must now be discarded. The presence of a median seta on P-3, the chaetotaxy of the dorsal plates, and the presence of three pairs of setae ventrally on PE are all characters that suggest a position nearer the Halacarinae.

The chaetotaxy of the body is distinctly more like that of the Halacarinae, in virtually all of which there are five pairs of dorsal setae, excluding the setae dorsal to the anus. In *Actacarus illustrans* there are four pairs of setae in PD, but it is obvious that the posterior pair are actually the adanal setae. These setae are conservative structures in the Halacaridae, present without exception in all species seen by the writer, but varying somewhat in position. In some genera they are located dorsally on the anal papilla (*Agaue, Agauopsis, Copidognathus*), while in *Thalassacarus commatops* they have a unique position on the ventral surface of the anal papilla. In other cases, such as in certain species of *Thalassarachna*, they have become displaced somewhat anteriorly and lie in the posterior margin of PD. This is the situation found in *Actacarus illustrans*. In the Rhombognathinae on the other hand, the number of dorsal setae is nine pairs in *Rhombognathides*

and *Metarhombognathus*, or two to four pairs in *Rhombognathus* and *Isobactrus*.[1]

Likewise, in the chaetotaxy of PE, *Actacarus* is more like most Halacarinae in which there are three ventral setae and one dorsal seta (*Copidognathus*, except *C. hummelincki*, most *Thalassarachna*, *Agauopsis*, *Halacarus*). In *Rhombognathides*, *Isobactrus*, and *Metahombognathus* there are only one dorsal and two ventral setae, while species of *Rhombognathus* have a total of five or six on PE.

The form of the palpi is more typical of the Halacarinae than of the Rhombognathinae. A clearly four-segmented palpi is found only in *Isobactrus* and *Rhombognathus*, and perhaps not in all species of these. In neither case is there a median seta on P-3, but such a seta is found in species of *Halacarus*, *Thalassarachna*, *Agauoupsis*, and *Agaue* (Halacarinae).

The similarity of the female genital opening to that of *Rhombognathides* is pronounced, but there are no real landmarks available to determine whether or not this is simply a parallelism. Under the circumstances, this one point is not sufficient to outweigh all the evidence that indicates a closer relationship to the Halacarinae.

While there are many differences between the description of *Actacarus illustrans* given above and that given by Schulz for *A. pygmaeus*, most of these would probably disappear upon a close comparison of the species themselves. There appears to be a difference in the distribution of the setae around the genital opening of the male, but this is the only one in which much reliance can be placed. The blunt, rounded rostrum indicated for *A. pygmaeus* may or may not be real. *A. illustrans* is a considerably larger species, ranging up to 250 $\mu$ in body length, compared with 150 $\mu$ for *A. pygmaeus*. Since *A. pygmaeus* is known only from the North Sea, it is probable that the species are distinct.

DISTRIBUTION: Unalaska Island, Alaska; Dutch Harbor, male holotype. Sand and gravel under large stones, intertidal. August 9, 1948. I. M. Newell.

[1] The classification of the Rhombognathinae proposed by the author (Newell, 1947, pp. 25–33, 39–80) has recently been reviewed critically by Viets (1950, pp. 18–19), who accepted none of the changes made by me. Viets placed the genera *Isobactrus* Newell, 1947, and *Metarhombognathus* Newell, 1947, in synonymy with *Rhombognathus* Trouessart, 1888. The morphological evidence against such a reversion is little short of overwhelming and far too extensive to present here. However, a detailed review of the generic classification of the Rhombognathinae has been prepared for publication at a later date.

**Lohmannella falcata** (Hodge) 1863, **beringi,** new subspecies

REMARKS: The forms from the Arctic Ocean, Bering Sea, and Aleutians key out to *Lohmannella falcata* (Hodge) in Viets' diagnostic table (1950, pp. 35–36). While some differences are apparent, these are minor; moreover, there is great variation in body size and the chaetotaxy of GA which the writer has thus far been unable to correlate with any other constant feature. Accordingly, I have concluded that the differences observed are intraspecific. Either *Lohmannella falcata* is highly variable, or there is a complex of several species, the distinguishing characters of which are so subtle that they have escaped detection up to the present.

The forms from Alaska have palpi which are appreciably heavier basally than distally, the basal height of P-3 being about 2.25 times as great as the distal height. In *L. falcata falcata* the height of P-2 at the base of the segment is only a little greater than the height at the slightly enlarged distal end. In the single specimen measured, P-2 was 3.4 times as long as P-4. All measurements were taken from drawings made at a linear magnification of 900. A very delicate accessory tooth is visible on favorably oriented lateral claws at magnifications of 430 and above.

DISTRIBUTION: Attu Island, Alaska; 1.5 miles northeast of Alexai Point, female holotype. On calcareous algae. June 25, 1948. I. M. Newell.

St. Paul Island, Alaska. Intertidal, on algae. June 29, 1946. V. B. Scheffer.

Arctic Ocean, about 18 miles northwest of Wainwright, Alaska (latitude 70° 53′ N., longitude 160° 05′ W.). Sand and gravel at depth of 130 feet. August 1, 1948. I. M. Newell.

## REFERENCES CITED

ANDRÉ, M.
1946. Halacariens Marins. Faune de France, vol. 46, pp. 1–152.
EDMONDSON, W. T.
1949. A formula key to the rotatorian genus *Ptygura*. Trans. Amer. Micro. Soc., vol. 68, no. 2, pp. 127–135.
NEWELL, I. M.
1947. A systematic and ecological study of the Halacaridae of eastern North America. Bull. Bingham Oceanogr. Coll., vol. 10, no. 3, pp. 1–232.
1949. New genera and species of Halacaridae (Acari). Amer. Mus. Novitates, no. 1411, pp. 1–22.

1950. New species of *Copidognathus* (Acari, Halacaridae) from the Aleutians. *Ibid.*, no. 1476, pp. 1–19.

1951a. New species of *Agaue* and *Thalassarachna* from the Aleutians (Acari, Halacaridae). *Ibid.*, no. 1489, pp. 1–19.

1951b. *Copidognathus curtus* Hall, 1912, and other species of *Copidognathus* from western North America (Acari, Halacaridae). *Ibid.*, no. 1499, pp. 1–27.

SCHULZ, E.

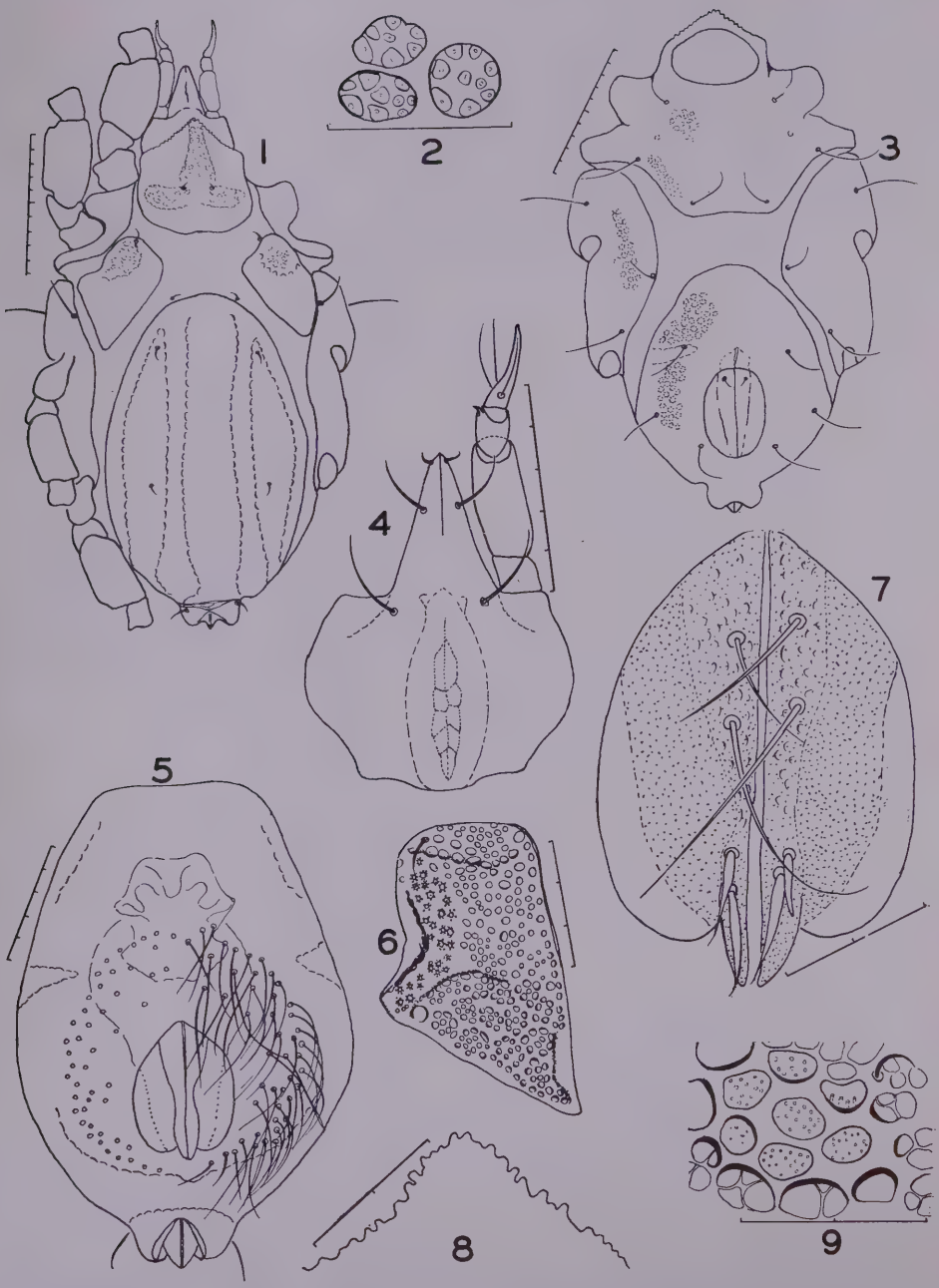
1936. *Actacarus pygmaeus* n. g. n. sp., eine merkwürdige Meeresmilbe aus der Otoplanen-Zone der Nordsee. Kieler Meeresforsch., vol. 1, no 2, pp. 327–331.

VIETS, K.

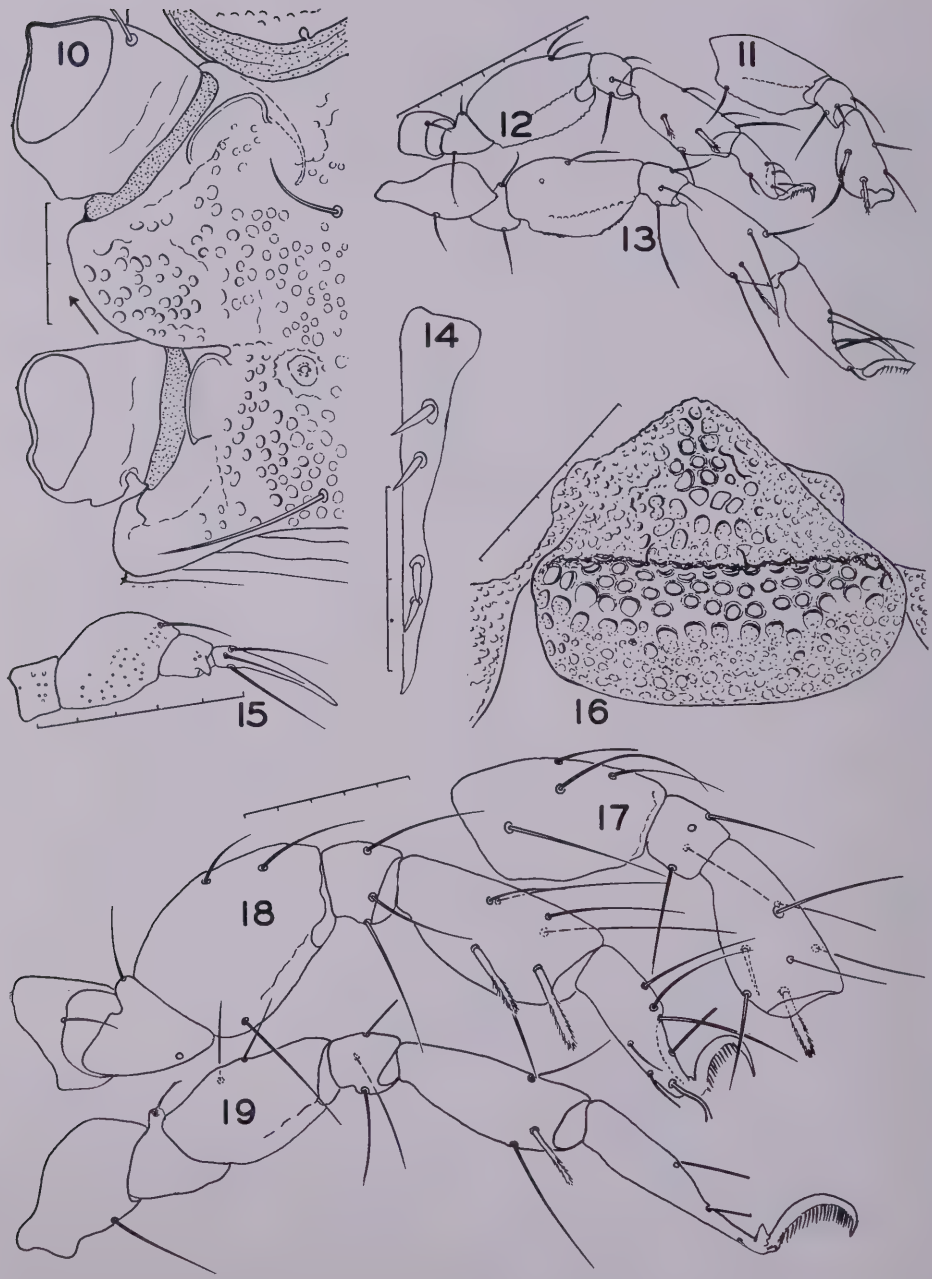
1939. Meeresmilben aus der Adria. (Halacaridae und Hydrachnellae, Acari.) Arch. Naturgesch., new ser., vol. 8, pp. 518–550.

1940. Meeresmilben aus der Adria. (Halacaridae und Hydrachnellae, Acari.) *Ibid.*, new ser., vol. 9, pp. 1–135.

1950. Die Meeresmilben (Halacaridae, Acari) der Fauna Antarctica. Further Zoological Results of the Swedish Antarctic Expedition, 1901–1903, vol. 4, no. 3, pp. 1–44.

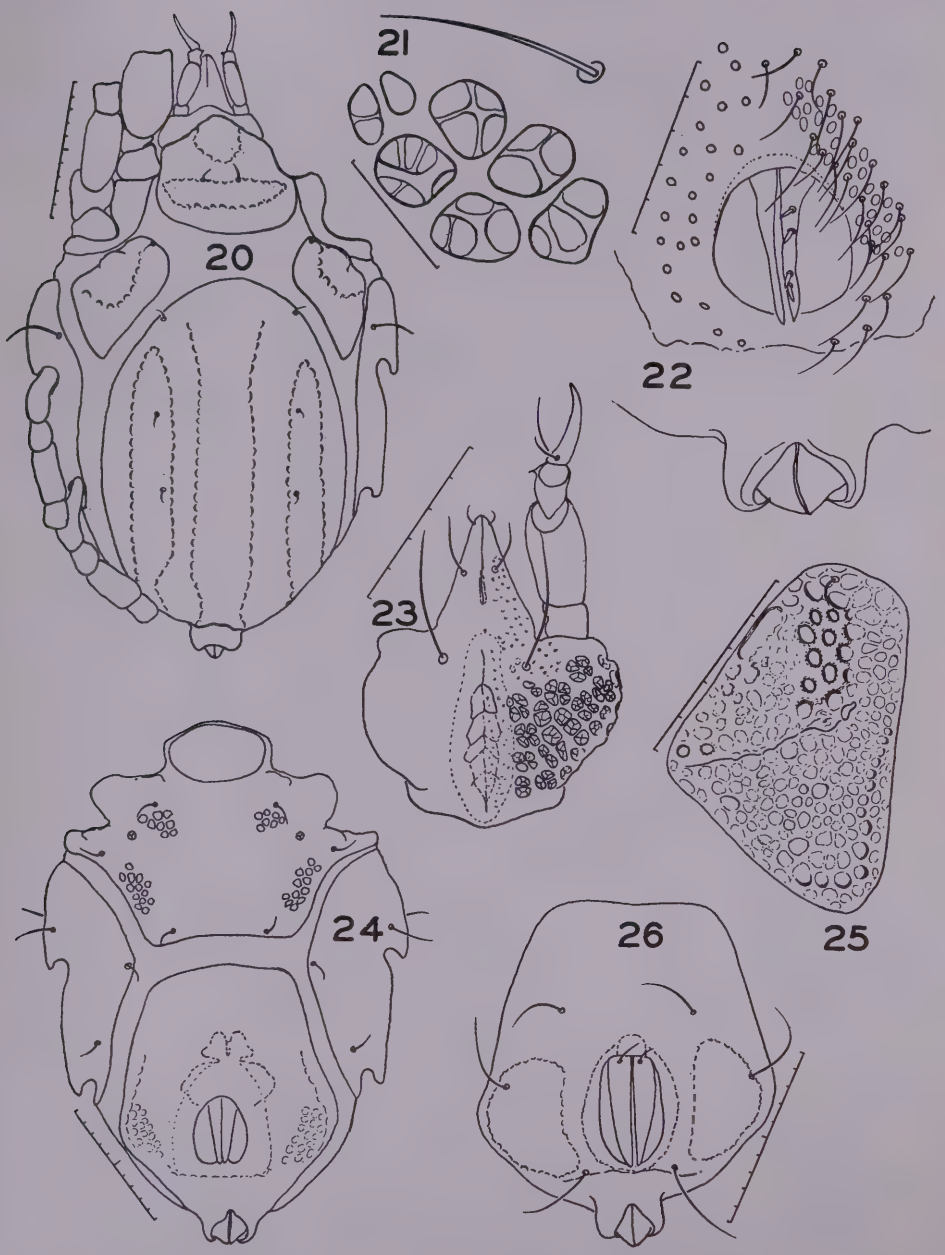



FIGS. 1–9. *Copidognathus styracifer*, new species. 1. Female, dorsum. 2. Female, porose panels of AE. 3. Female, venter. 4. Female, capitulum. 5. Male, GA. 6. Female, OC. 7. Male, genital opening. 8. Female, outline drawing of anterior margin of AD. 9. Female, porose areas of AD.

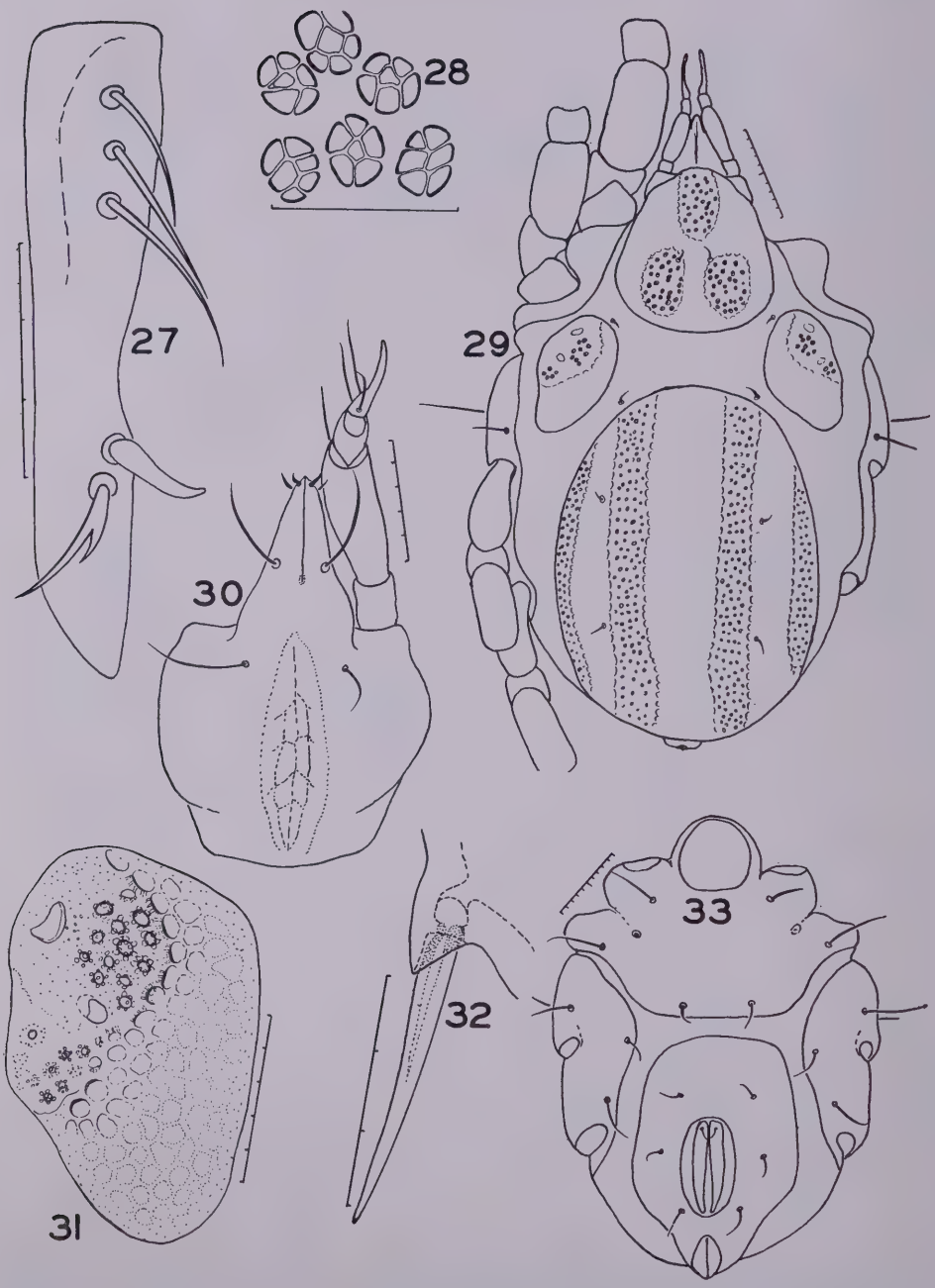



FIGS. 10–13. *Copidognathus styracifer*, new species. 10. Male, lateral portion of AE, showing epimeral processes of right side. Arrow points anteriorly. 11. Female, leg II in part, medial view. 12. Female, leg I, medial. 13. Female, leg III, medial view.

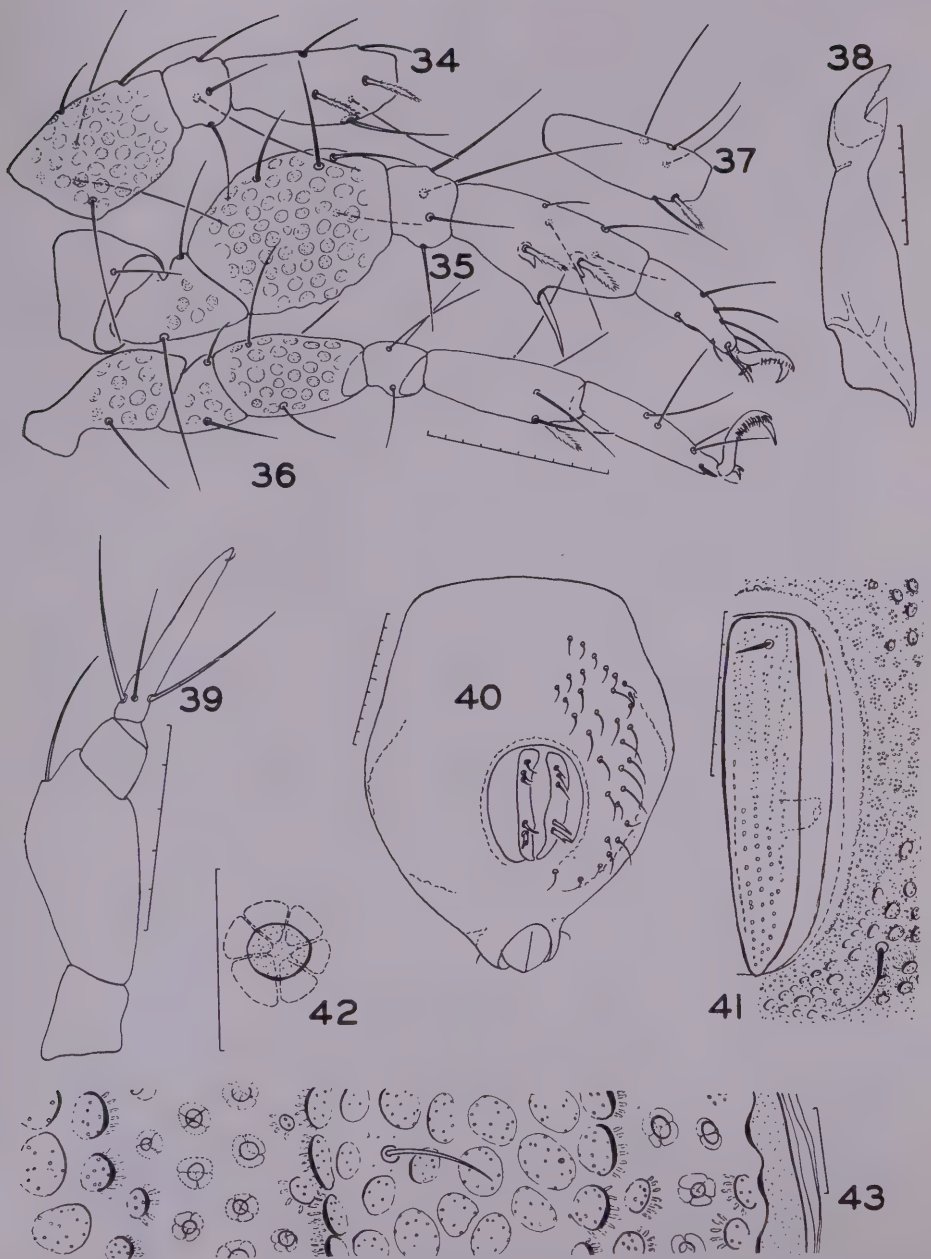
FIGS. 14–19. *Copidognathus imitator*, new species. 14. Male, genital sclerite. 15. Male, palp, medial view. 16. Male, AD. 17. Female, leg II in part, lateral view. 18. Female, leg I, medial view. 19. Female, leg III, medial view (some setae missing).



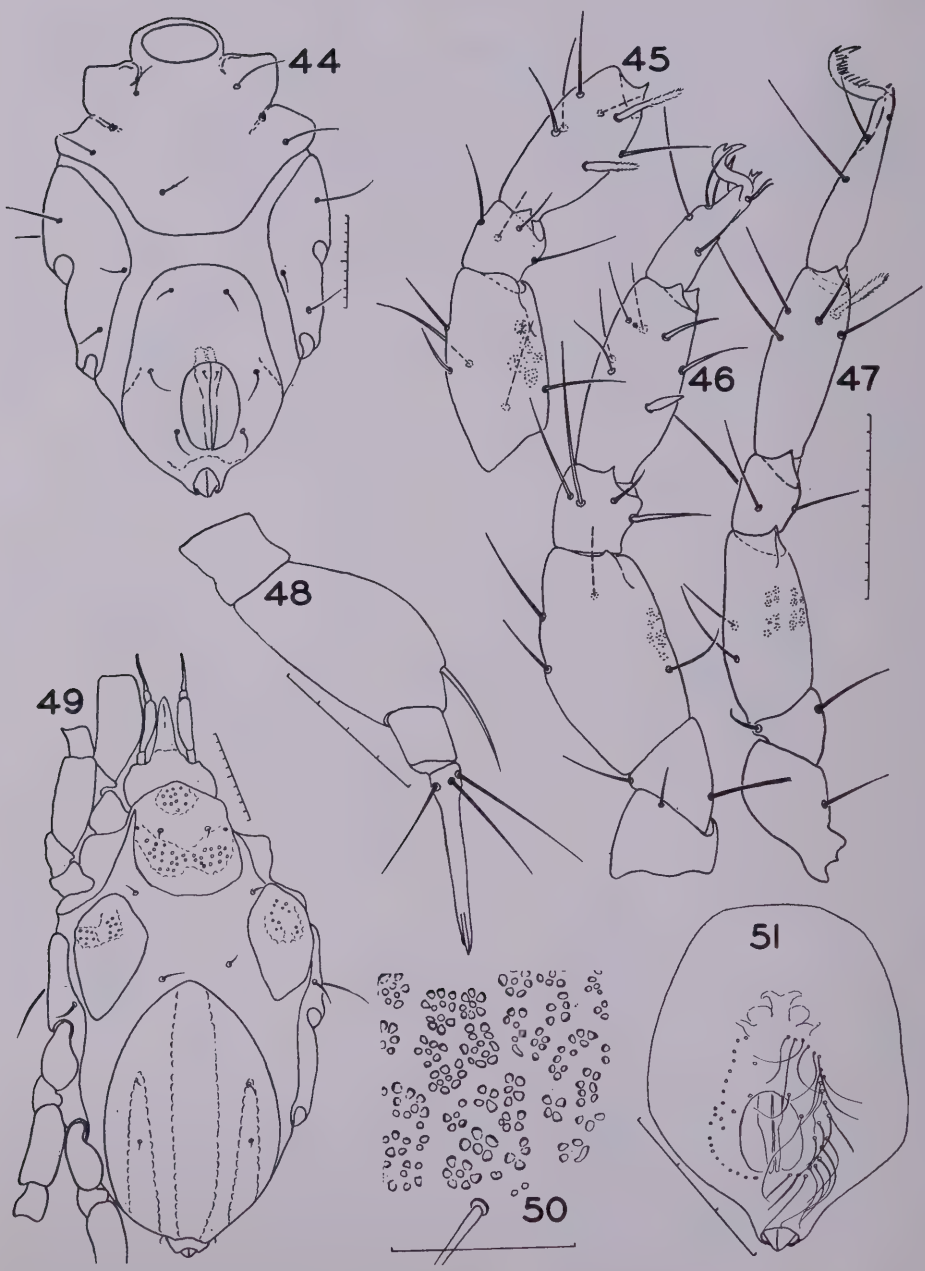

FIGS. 20–26. *Copidognathus imitator*, new species. 20. Male, dorsum, 21. Male, porose area near anterior seta of AE. 22. Male, genital opening. 23. Male, capitulum. 24. Male, venter. 25. Male, OC of left side. 26. Female, GA.



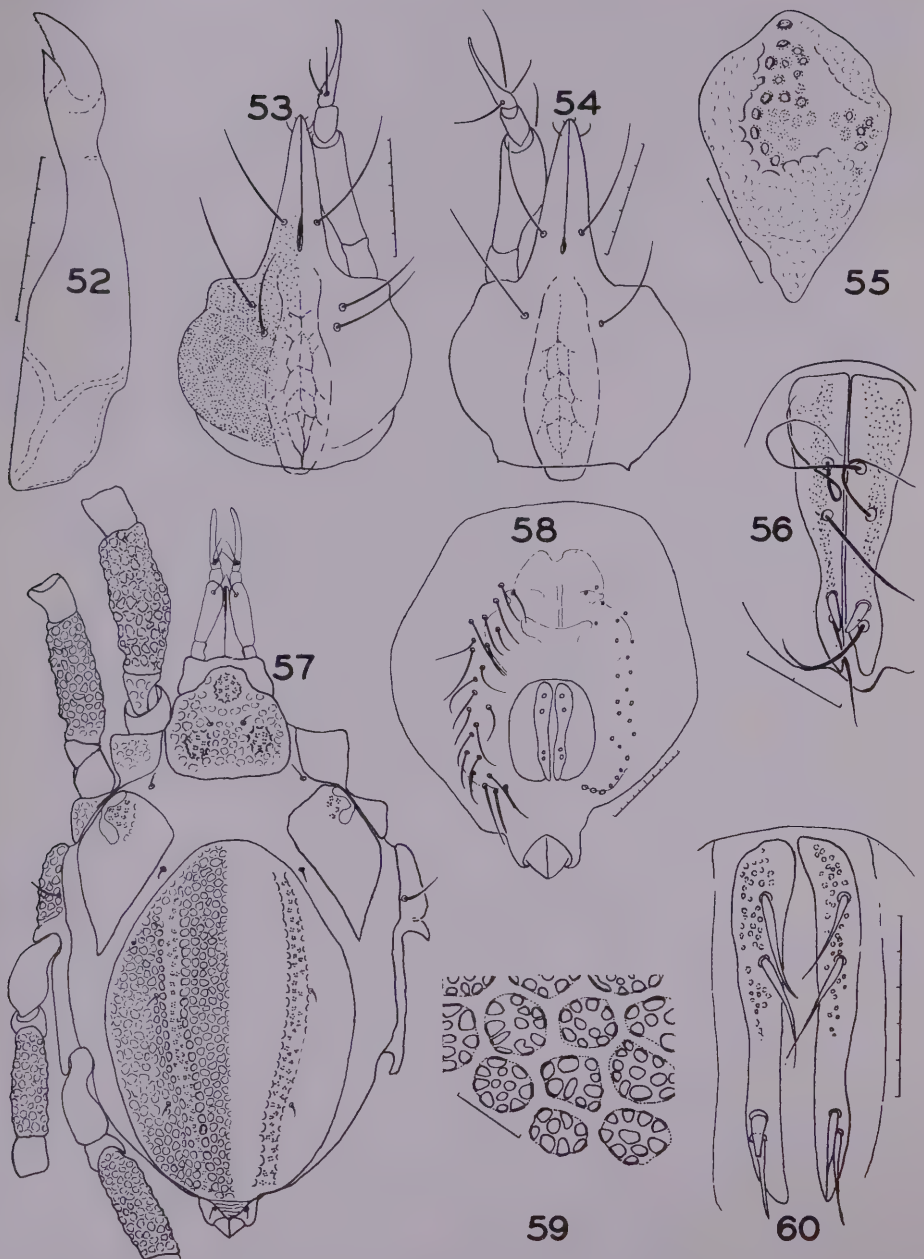

FIGS. 27–33. *Copidognathus nubilobius*, new species. 27. Male, genital sclerite. 28. Male, panels on base of capitulum. 29. Female, dorsum. 30. Female, capitulum. 31. Male, OC 32. Male, ventral seta of I-5. 33. Female, venter.




FIGS. 34–43. *Copidognathus nubilobius*, new species. 34. Male, leg II in part, medial view. 35. Male, leg I, medial view. 36. Male, leg III, lateral view. 37. Male, IV-5, medial view. 38. Male, chelicera. 39. Male, palp. 40. Male, GA. 41. Female, genital opening. 42. Female, rosette pore of AD. 43. Female, PD at level of fourth dorsal seta.



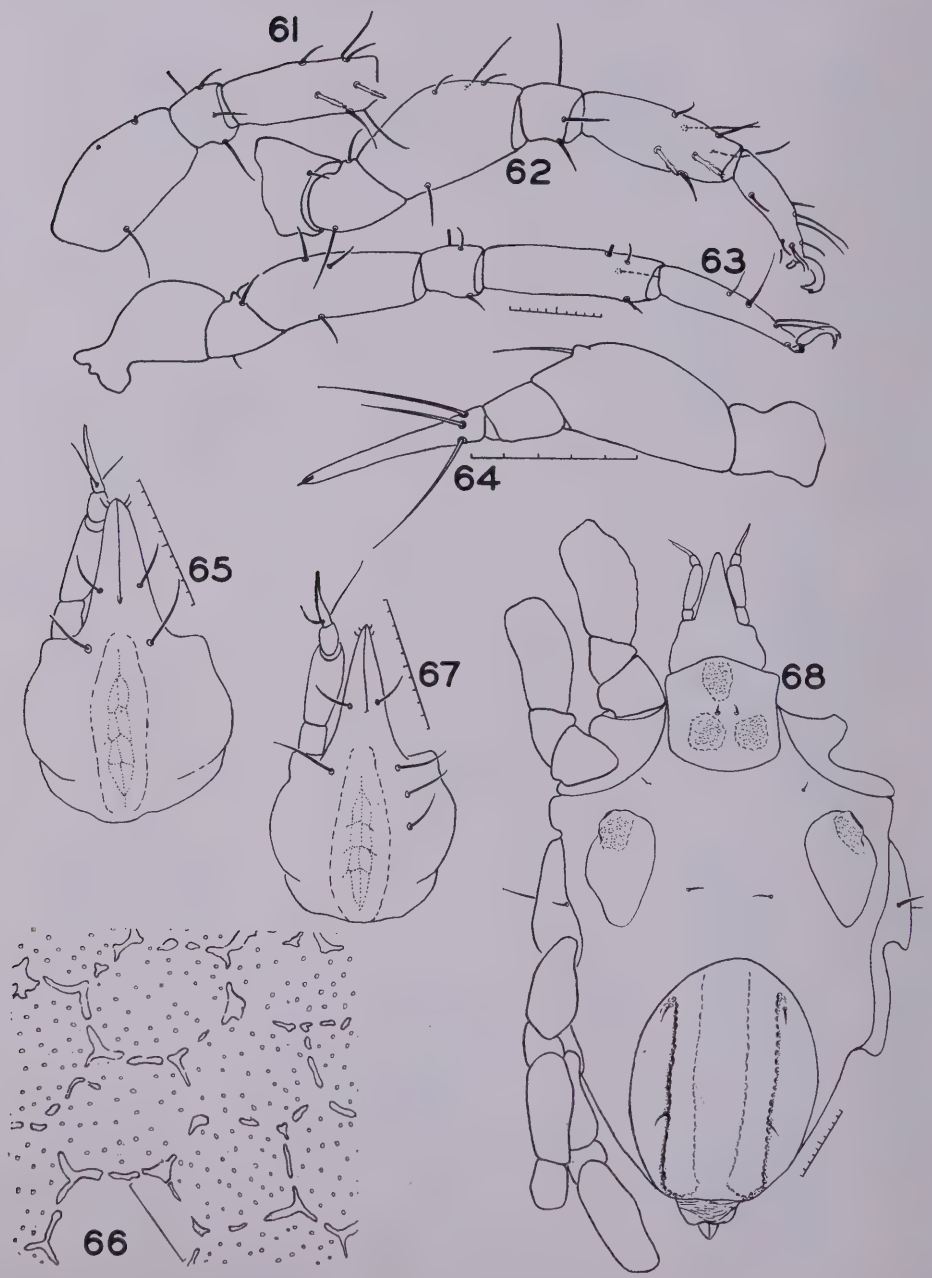

FIGS. 44–51. *Copidognathus unalaskensis*, new species. 44. Female, venter. 45. Female, leg II in part, medial view. 46. Female, leg I, medial view. 47. Female, leg III, lateral view. 48. Female, palp. 49. Female, dorsum. 50. Male, porose panels of I-3. 51. Male, GA.




FIGS. 52–56. *Copidognathus unalaskensis*, new species. 52. Male, chelicera. 53. Male, capitulum. 54. Female, capitulum. 55. Female, caudate form of OC. 56. Male, genital sclerites.

FIG. 57. *Copidognathus aurorae* Newell, 1951. Male, dorsum (St. Paul Island).

FIGS. 58–60. *Copidognathus gigas*, new species. 58. Male, GA. 59. Female, posterior porose area of AD. 60. Male, genital sclerites.




FIGS. 61–68. *Copidognathus gigas*, new species. 61. Female, leg II in part, medial view. 62. Female, leg I. 63. Female, leg IV. 64. Male, palp. 65. Female, capitulum. 66. Female, paneling of I-3. 67. Male, capitulum of an exceptional specimen. 68. Female, dorsum.

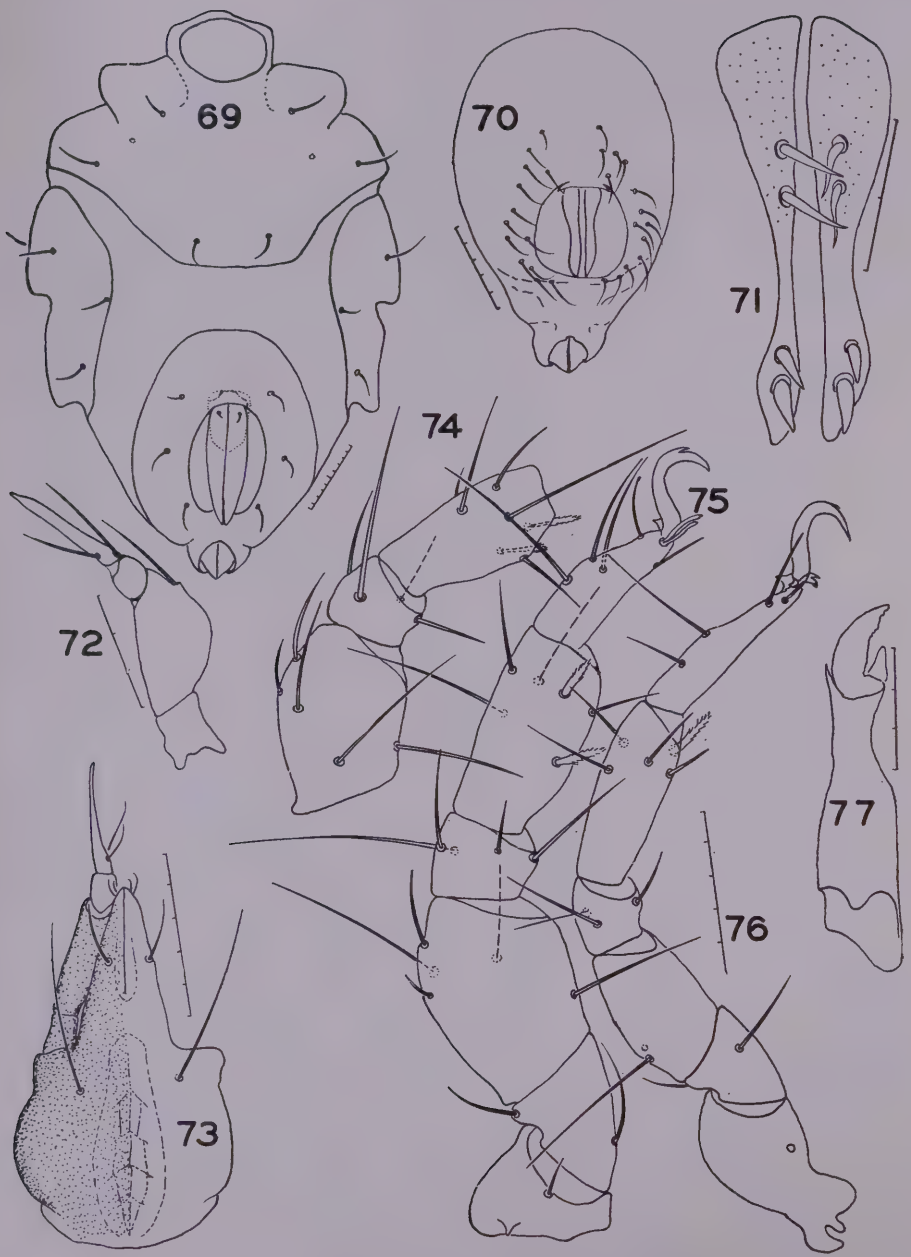
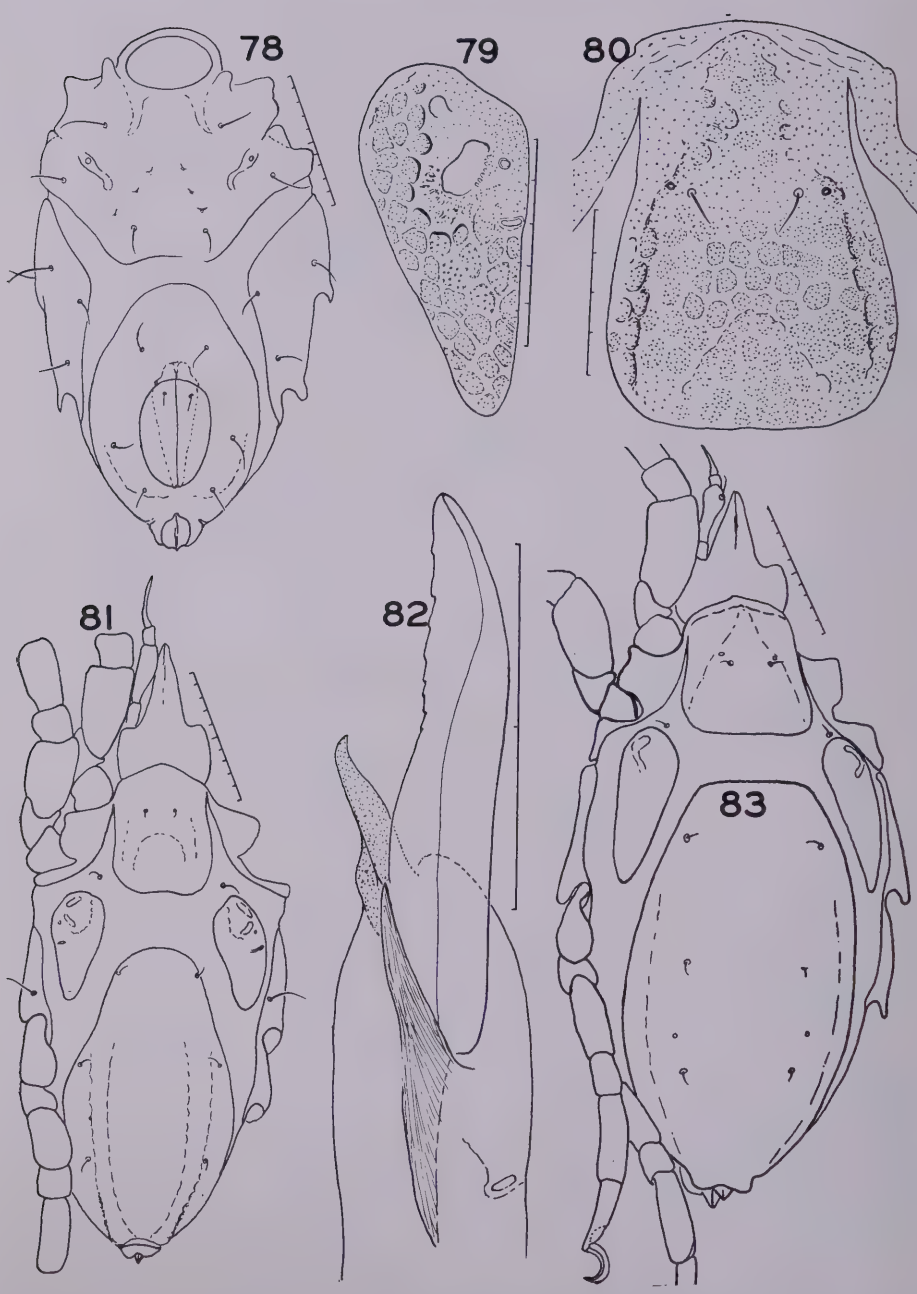


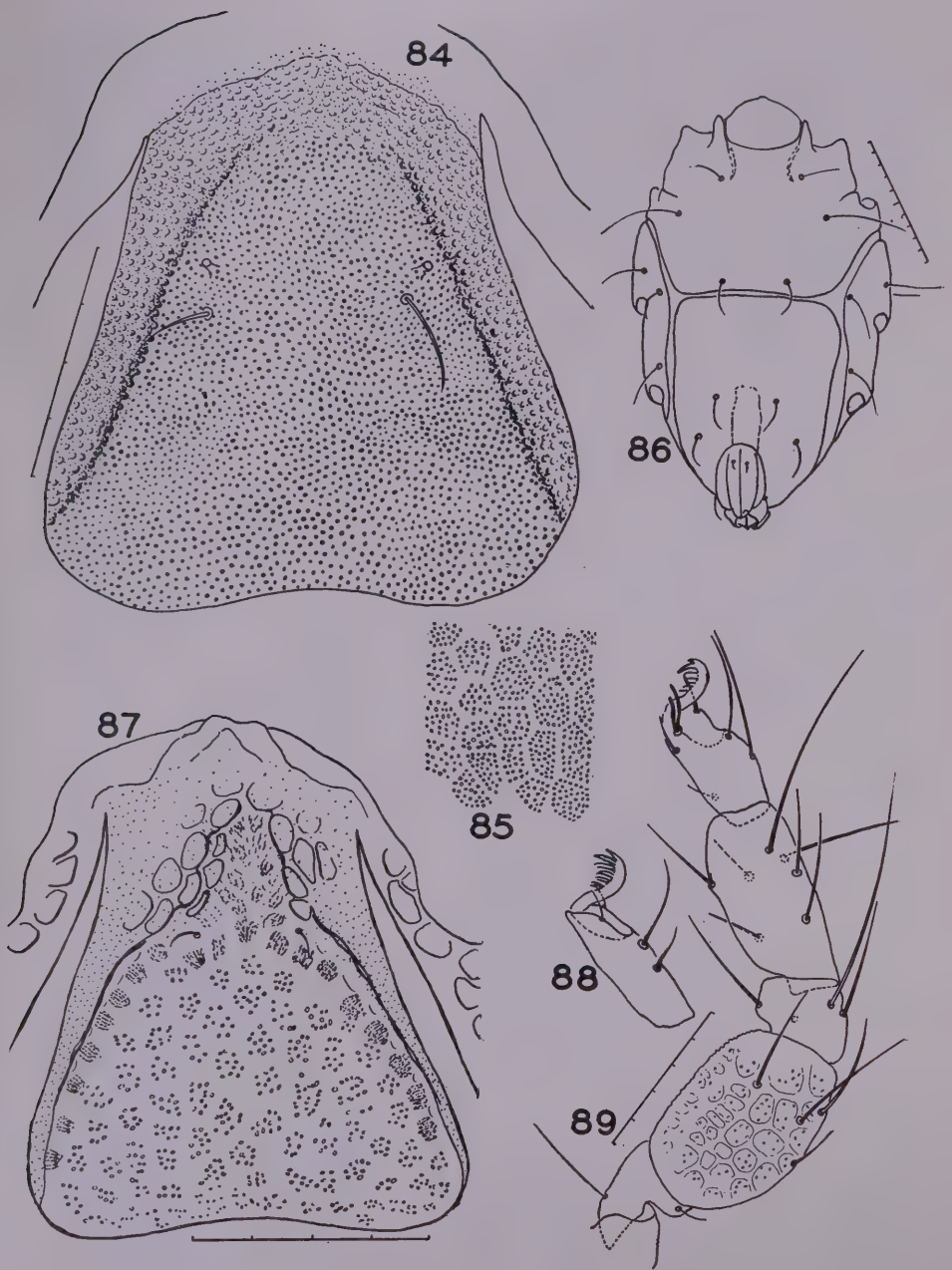

FIG. 69. *Copidognathus gigas*, new species. Female, venter.

FIGS. 70–77. *Copidognathus diaphaneus*, new species. 70. Male, GA. 71. Male, genital sclerites. 72. Male, palp. 73. Female, capitulum. 74. Female, leg II in part, lateral view. 75. Female, leg I, medial view. 76. Female, leg III, lateral view. 77. Male, chelicera.



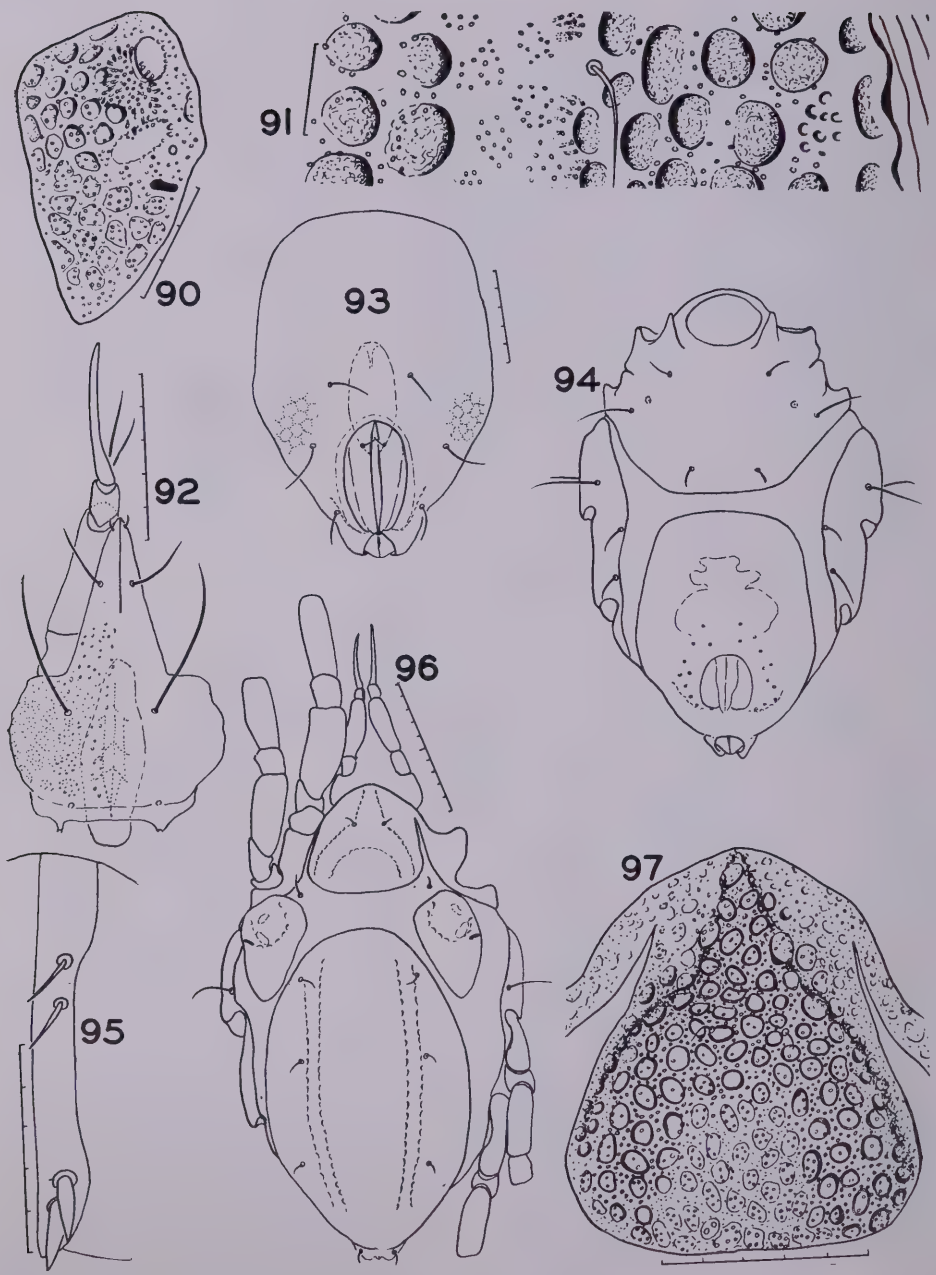

FIGS. 78–82. *Copidognathus diaphaneus,* new species. 78. Female, venter, 79. Male, OC. 80. Female, AD. 81. Female, dorsum. 82. Male, ventral view of tarsus of chelicera and associated structures.

FIG. 83. *Copidognathus punctatus* Newell, 1950. Female, dorsum.

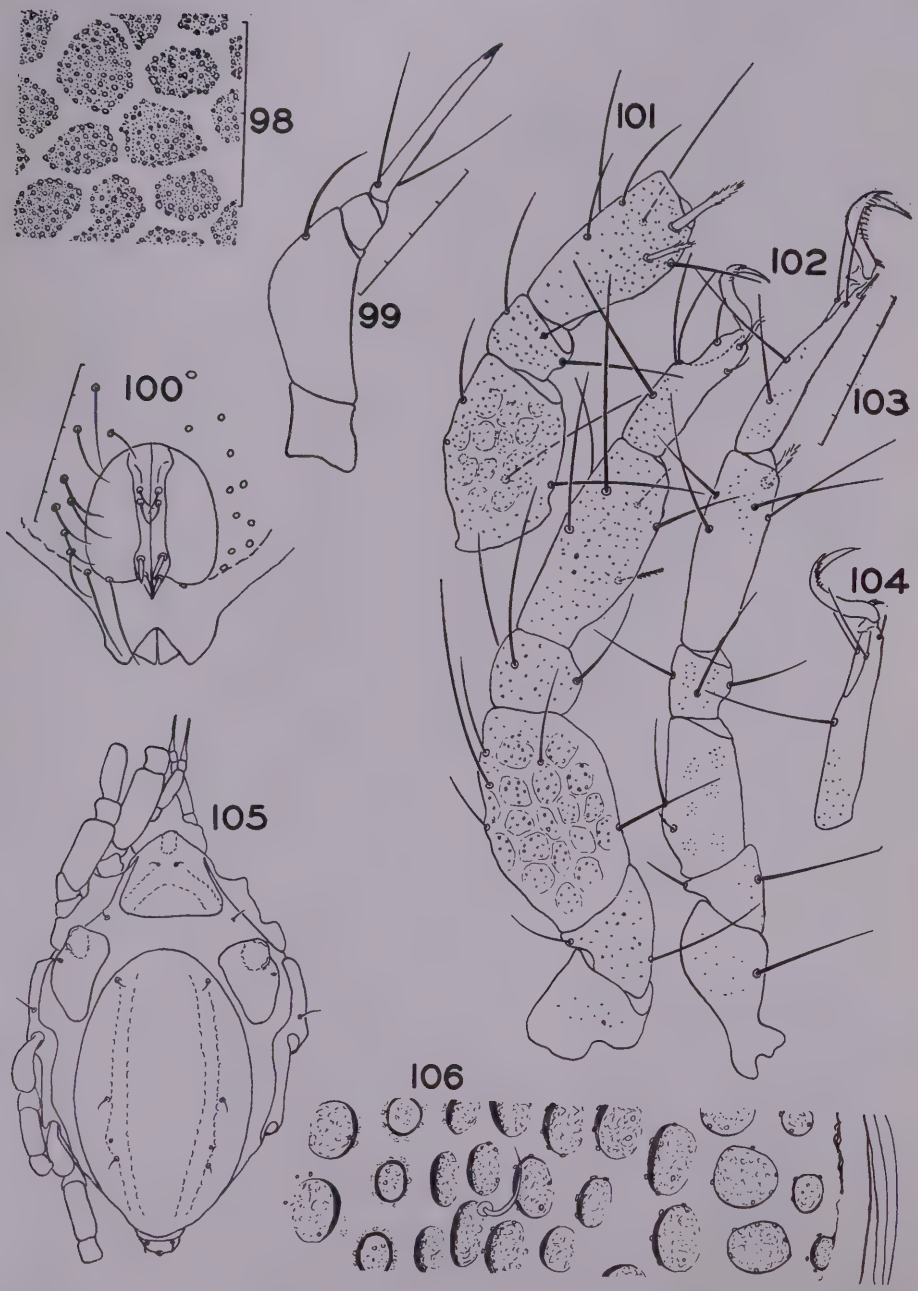



FIGS. 84–85. *Copidognathus punctatus*, Newell, 1950. 84. Female, AD. 85. Portion of AD of a paneled form.

FIGS. 86–89. *Copidognathus parapunctatus* Newell, 1950. 86. Female, venter. 87. Female, AD. 88. Male, III-6. 89. Male, leg I, somewhat rotated.

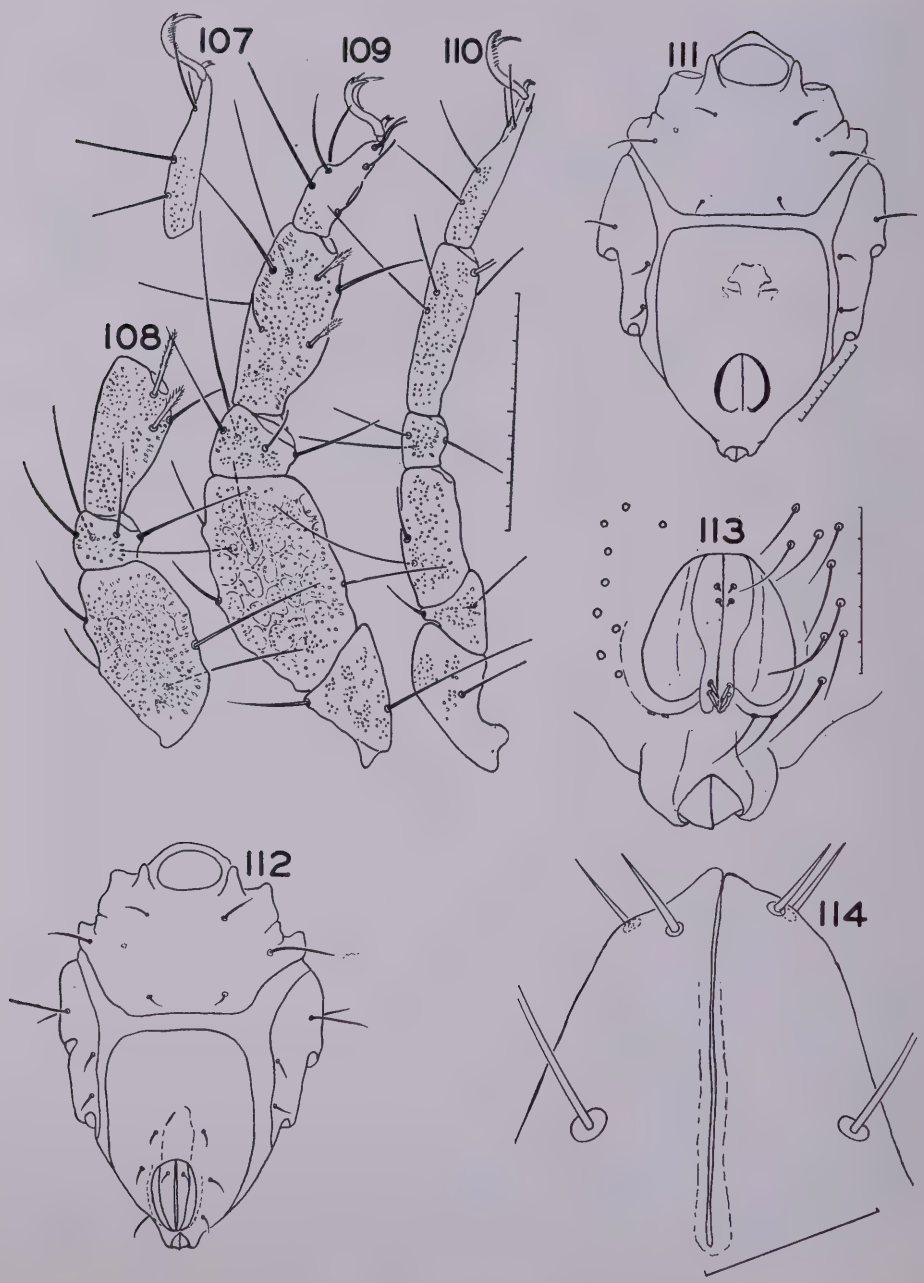



FIGS. 90–97. *Copidognathus arcticus*, new species. 90. Male, OC. 91 Male, PD at level of fourth dorsal seta. 92. Male, capitulum. 93. Female, GA. 94. Male, venter. 95. Male, genital sclerite. 96. Male, dorsum. 97. Male, AD.



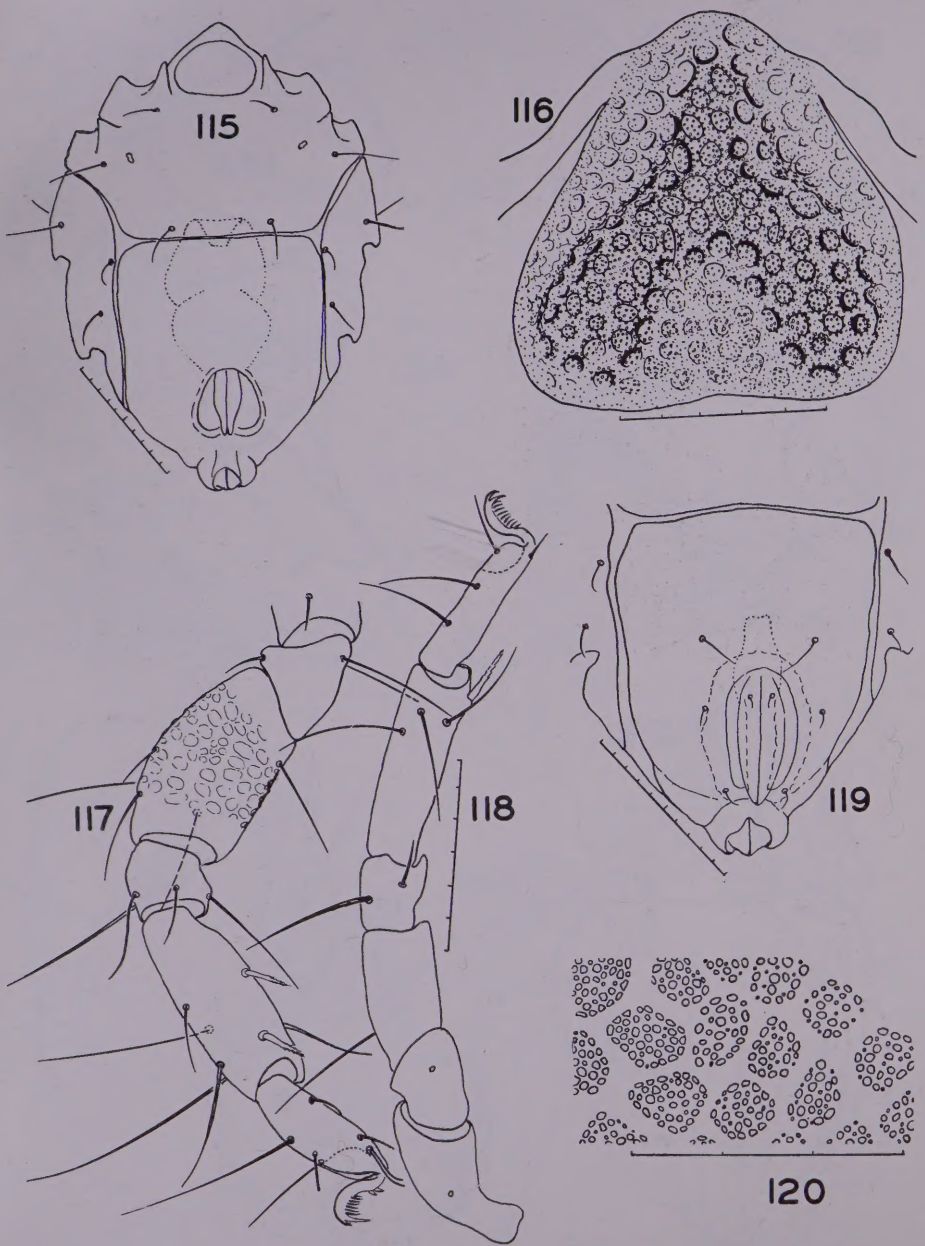

FIGS. 98–104. *Copidognathus arcticus*, new species. 98. Male, AE. 99. Male, palp. 100. Male, genital opening. 101. Male, leg II in part, medial view. 102. Male, leg I, lateral view. 103. Male, leg III, lateral view. 104. Male, IV-6.

FIGS. 105–106. *Copidognathus similis*, new species. 105. Male, dorsum. 106. Male, PD at level of fourth dorsal seta.

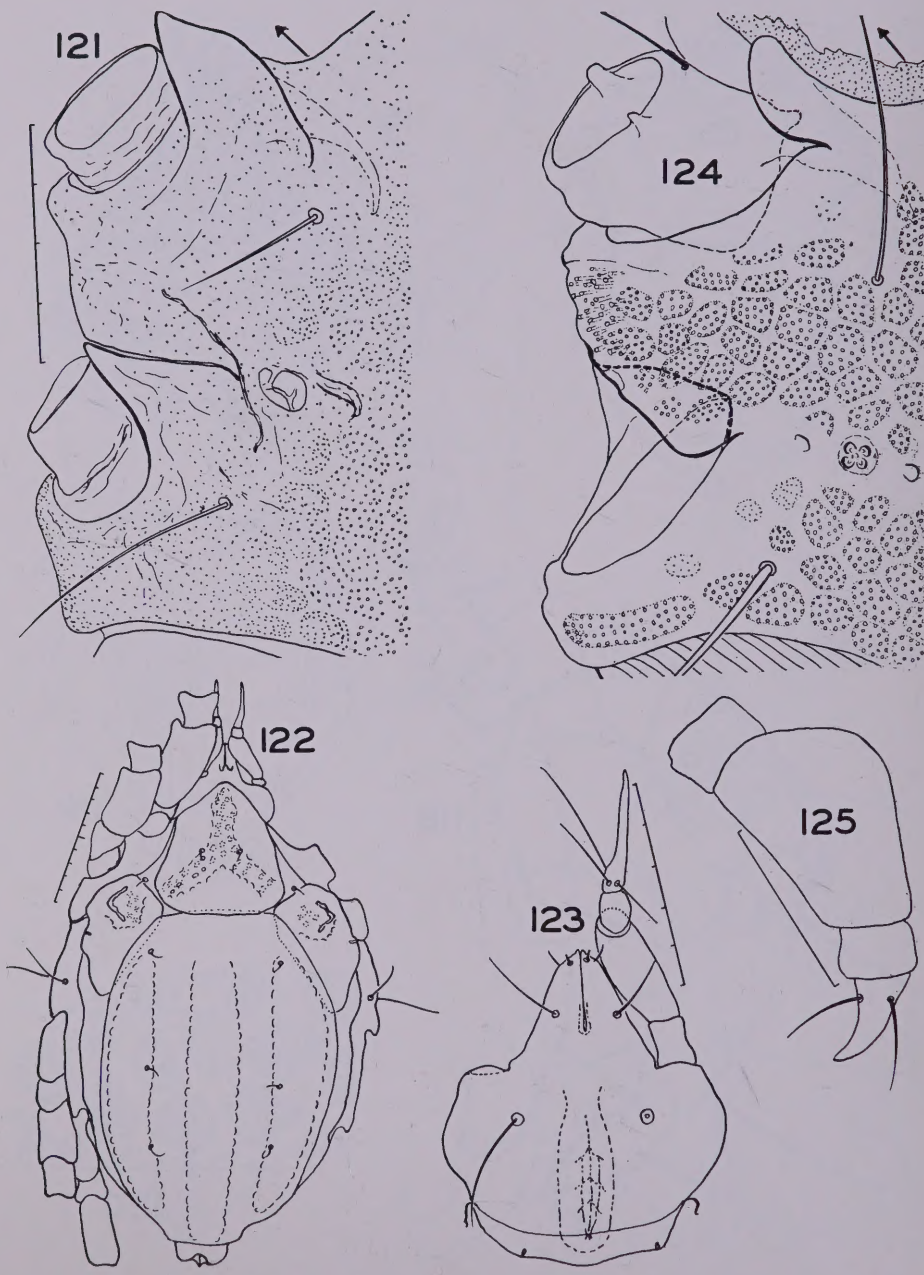



FIGS. 107–112. *Copidognathus similis*, new species. 107. Male, IV-6. 108. Male, leg II in part, medial view. 109. Male, leg I, medial view. 110. Male, leg III, medial view. 111. Male, venter. 112. Female, venter.

FIGS. 113–114. *Copidognathus brevimaxillaris*, new species. 113. Male, genital opening. 114. Female, tip of rostrum.



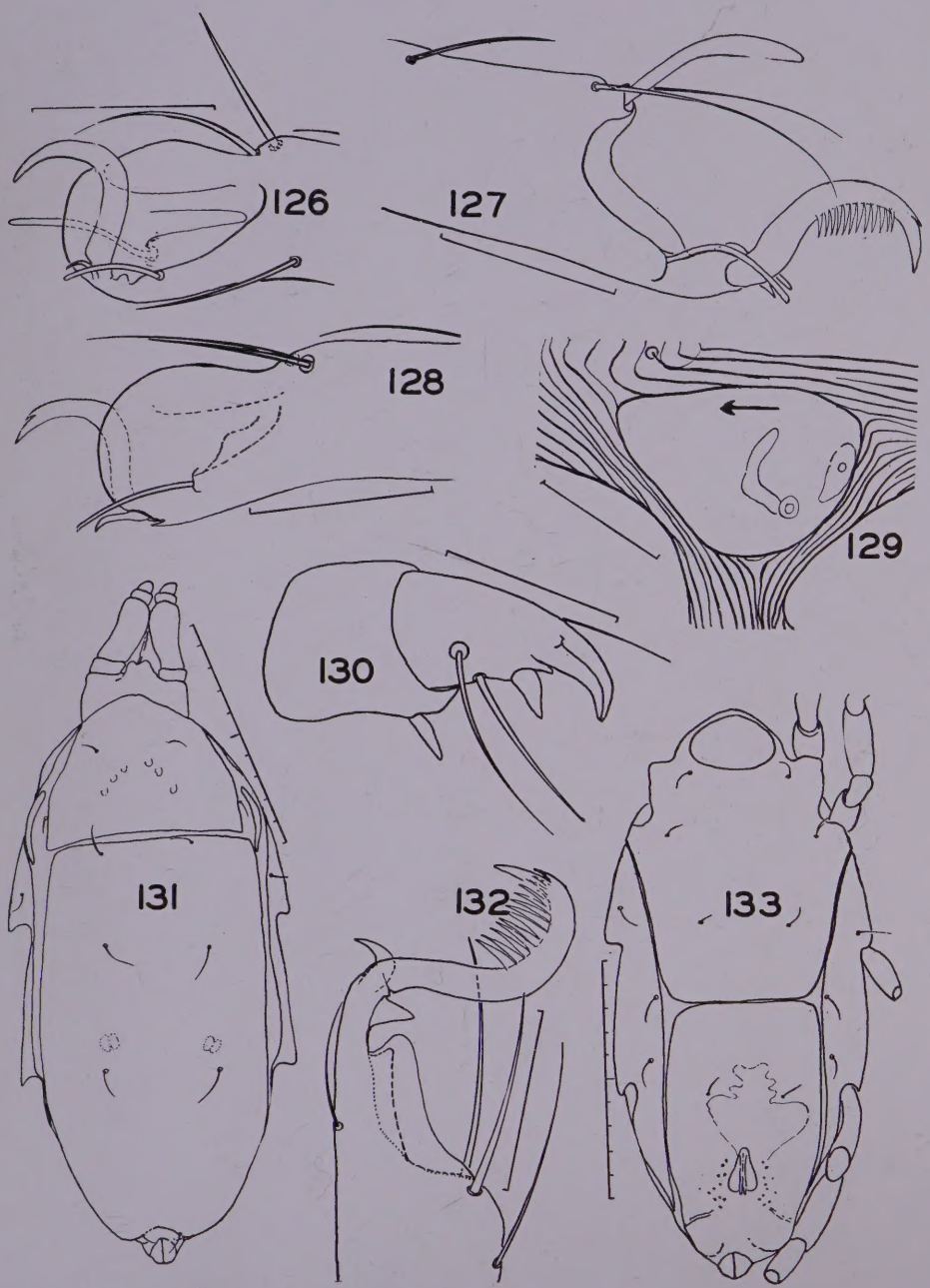

FIGS. 115–120. *Copidognathus brevimaxillaris*, new species. 115. Male, venter. 116. Female, AD. 117. Female, leg I, rotated. 118. Female, leg III, ventrolateral view. 119. Female, GA. 120. Male, porose panels of AE.



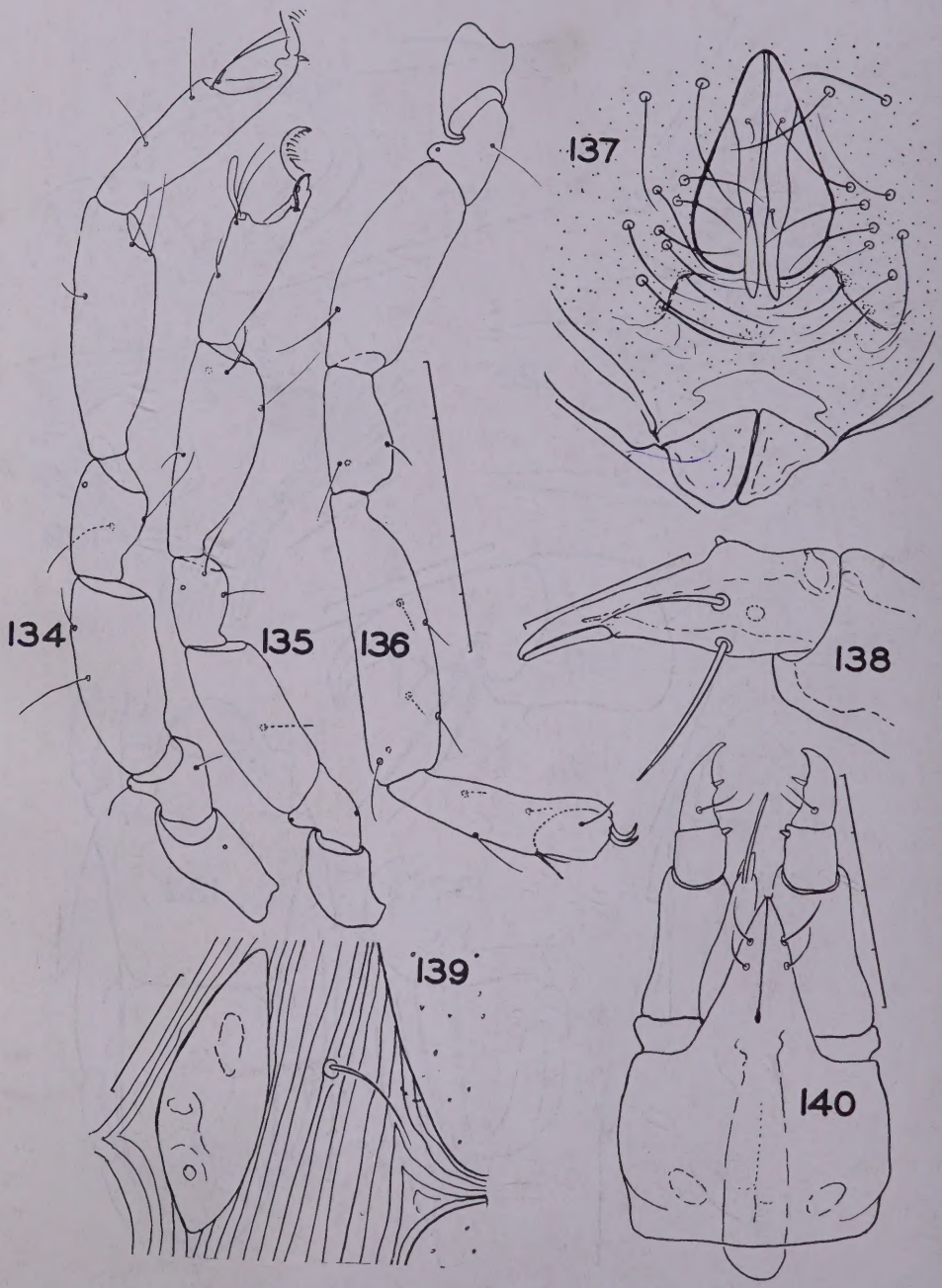

FIGS. 121–123. *Copidognathus brevimaxillaris*, new species. 121. Female (teneral), lateral portion of AE, showing epimeral processes. Arrow points anteriorly. 122. Male, dorsum. 123. Male, capitulum.

FIG. 124. *Copidognathus punctatissimus* (Gimbel), 1919. Female; compare with figure 121.

FIG. 125. *Actacarus illustrans*, new species. Male, palp.




FIGS. 126–133. *Actacarus illustrans*, new species. 126. Male, I-6, medial view. 127. Male, II-6. 128. Male, I-6, lateral view. 129. Nymph, AE, OC, and PE of left side, dorsolateral view. Note seta. 130. Male, P-3 and P-4. 131. Male, dorsum. 132. Male, IV-6. 133. Male, venter.




FIGS. 134–140. *Actacarus illustrans*, new species. 134. Male, leg III, medial view. 135. Male, leg II, lateral view. 136. Male, leg I, lateral view, 137. Male, genital opening. 138. Female, P-4, lateral view. 139. Female, OC of left side. Portions of AD and PD shown. 140. Male, capitulum.